

PROJECT MANUAL FOR: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR
REPLACEMENT

PROJECT NUMBER: CP252301

AT
CAPITAL REGION MEDICAL CENTER
JEFFERSON CITY, MISSOURI

FOR:

THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

SSC Engineering

DATE: **July 8, 2025**

I hereby certify that 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.

(seal) Signature:  _____

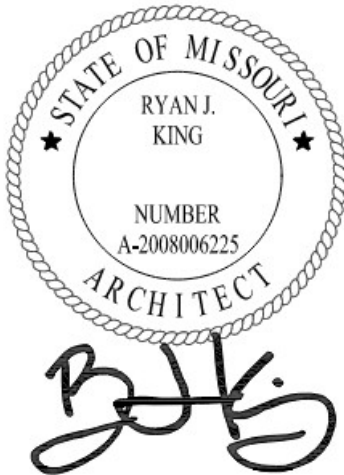


(Mechanical, Electrical, Plumbing, and Fire Protection)

DATE: July 8, 2025

I hereby certify that 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.

Sections certified under my seal: 024119 Selective Demolition, 033000 Cast in Place Concrete, 078413 Penetration Firestopping, 078443 Joint Firestopping, 079200 Joint Sealants, 079219 Acoustical Joint Sealants, 081113 Hollow Metal Doors and Frames, 081416 Flush Wood Doors, 083113 Access Doors and Frames, 087100 Door Hardware, 092216 Non Structural Metal Framing, 092900 Gypsum Board, 099113 Exterior Painting, 099123 Interior Painting



Date: 07.08.2025

(Architectural)

DATE: **July 8, 2025**

I hereby certify that 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.

Sections certified under my seal: 311000 Site Clearing & Demolition, 312000 Earthmoving, 312500 Erosion Control, 321313 Concrete Paving, 321373 Concrete Paving Joint Sealants, & 329219 Seeding.



Signature: _____

(Civil)

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PLANNING DESIGN & CONSTRUCTION

900 E. Stadium, Ste. 130
Columbia, Missouri 65211
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

CAPITAL REGION MEDICAL CENTER –
SWITCHGEAR REPLACEMENT
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI
PROJECT NUMBER: CP252301

CONSTRUCTION ESTIMATE: \$2,025,000 - \$2,250,000

will be received by the Curators of the University of Missouri, Owner, at Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., August 19, 2025 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 Jeremy Schuette with SSC Engineering at (636) 530-7770 or jschuette@sscengineering.com. Questions regarding commercial conditions should be directed to Ben Myers at (573) 884-8458 or bmyers@missouri.edu.

A prebid meeting will be held at 1:00 p.m., C.T., July 30, 2025 at Capital Region Medical Center, 1125 Madison St., Jefferson City, MO in the Tunnel/Wherritt Conference Room, followed by a site walk-through.

A Diversity Participation goal of 10% MBE, 10% WBE, 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) 882-6800.

Advertisement Date: July 17, 2025

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 Corporations(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Assistant Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri – Columbia
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by SSC ENGINEERING, entitled "CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT" project number CP252301, dated 7/8/25 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 proposed 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 the following addenda:

Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____

2. In the 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

replace existing electrical distribution equipment including switchgear, main-tie-main main switchboard, switchboard, automatic transfer switches, and associated utility connections site work and construction of new electrical room within the existing hospital building. all as indicated on the Drawings and described in these Specifications for a sum of: _____ DOLLARS (\$ _____).

b. Unit Prices:

- (1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instruction of the Owner's Representative, the following Unit Prices shall prevail in accordance with the General Conditions.
- (2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliance, 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's Representative.
- (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 the Owner's Representative.
- (6) Rock Excavation in addition to soil excavation, as defined in Division 31, per cu. yd.
 - (a) Trenching,
Base Bid quantity = 20 cu. yd. \$ _____ / cu. yd.

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 five hundred and sixty (560) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been

allocated in construction schedule for receiving aforementioned document 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 the Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.
- c. Special Scheduling Requirements – shut downs areas affected by outages, and scheduling of outages for the hospital. Negative pressure shall be maintained in construction area to prevent dust spread to areas outside of work.

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.

Work to be performed	Subcontractor Name, City, and State
Electrical Contractor	
Mechanical Contractor	
Plumbing Contractor	

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

- a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of TEN PERCENT (10%), with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business Enterprise, of TEN PERCENT (10%), with Service-Disable Veteran Owned Business (SDVE) of THREE PERCENT (3%) of awarded contract price for work to be performed.
- b. Request for waiver of this goal shall be submitted on the attached Application For Waivers 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 proposed to perform work with following Supplier Diversity participation level:

 MBE PERCENTAGE PARTICIPATION:
 _____ percent (_____%)

 WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION
 _____ percent (_____%)

 SDVE 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 ACKNOWLEDGEMENTS

- 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 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 or 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."

END OF BIDDER'S CERTIFICATE

9. BIDDER'S SIGNATURE

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

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	
Fax No.	E-Mail Address
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 FOR ASBESTOS ABATEMENT

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

1. Company Name _____ Phone# _____

Address _____

2. State of Missouri Registration number _____

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

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

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

5. General character of work performed by your company personnel.

6. 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.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed

7. Other experience qualifying you for the work now bid.

8. 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 _____

9. (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 _____

- (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 _____

10. 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.)

11. 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.)

12. Workers Compensation Experience Modification Rates (last 3 yrs): _____ / _____ / _____

Incidence Rates (last 3 years): _____ / _____ / _____

13. List banking references.

14. (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 Served 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: _____

APPLICATION FOR WAIVER

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)
)
County of) ss.

_____ 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/slhc/

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.slmhc.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
W: www.flystl.com/business/business-diversity-development-1/directories

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.mwdbe.com/?TN=kcmohrd

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

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.mwdbe.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: oa.mo.gov/sites/default/files/sdvelisting.pdf
oeo.mo.gov/

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.stlamerican.com

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

	Scope of Work	Bid/Contract Amount	Final Dollar Amount
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

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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1. Contract Documents and Definitions

1.1 The “Drawings,” “Specifications,” and “Contract Documents” are defined in the “General Conditions of the Contract for Construction.”

1.2 The Drawings, Specifications, and other Contract Documents may be obtained as indicated in the Advertisement for Bids.

1.3 As used herein, “Bid” refers to an offer or proposal submitted to the Owner to enter into a contract for the work identified in the Drawings, Specifications and other Contract Documents.

1.4 As used herein, “Bidder” means an individual or business entity that submits a Bid to the Owner as a prime bidder or general contractor.

1.5 All other terms used herein shall have the meanings defined herein or in the General Conditions of the Contract for Construction or other Contract Documents.

2. Bidder Obligations

2.1 Before submitting a Bid, each Bidder shall carefully examine the Drawings and Specifications and related Contract Documents, visit the site of the work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters that could affect the work or the cost thereof.

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 specified in the Drawings, Specifications, and other Contract Documents. All work shall be done as defined in the Specifications and as indicated on the Drawings.

2.3 Failure or omission of any Bidder to receive or to examine any form, instrument, addendum, or other document, or to visit the site of the work and acquaint themselves with existing conditions, shall in no way relieve the Bidder from any obligation with respect to their Bid or any awarded contract. No extra compensation will be allowed concerning any matter about which the Bidder should have fully informed themselves prior to submitting a Bid.

2.4 Submission of a Bid shall be deemed acceptance by the Bidder of the above obligations and every obligation required by the Contract Documents in the event the Bid is accepted by the Owner.

3. Interpretation of Documents

3.1 If any prospective Bidder is in doubt about the meaning of any part of the Drawings, Specifications, or

other Contract Documents, the Bidder shall submit a written request to the Architect for an interpretation.

3.2 Any request for interpretation shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

3.3 A Bid shall be based only on an interpretation issued in the form of an addendum mailed to each person or business entity that is on the Architect’s record as having received a set of the Contract Documents.

3.4 Bidders shall not be entitled to rely on oral interpretations or written statements not issued in an addendum from either the Architect or a representative, agent, or employee of the Owner.

4. Bids

4.1 Bids shall be submitted on a single “Bid for Lump Sum Contract” form (“Bid Form”) as furnished by the Owner or Architect. Bids shall be received separately or in combination as required by Bid Form

4.2 In addition to the Bid Form, the Bid shall include any documents or information required to be submitted by this Information for Bidders or the Contract Documents.

4.3 Bids shall include amounts for alternate bids, unit prices, and cost accounting data where required by the Bid Form.

4.4 Bidders shall apportion each base Bid between various phases of the work, where stipulated in the Bid Form.

4.5 Bids shall be presented in sealed envelopes, which shall be plainly marked “Bids for (indicate name of project from cover sheet)” and mailed or delivered to the building and room number specified in the Advertisement for Bids.

4.6 Each Bidder shall be responsible for actual delivery of their bid 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.

4.7 The Bidder’s price shall include all federal sales, excise, and similar taxes that may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City and State taxes shall not be included as stated in the General Conditions of the Contract for Construction.

4.8 No Bidder shall stipulate in their Bid any conditions not contained in the Bid Form or Contract Documents. Inclusion of any additional conditions or taking exception to any terms may result in rejection of the Bid.

4.9 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 A Bidder may withdraw their Bid at any time before the scheduled closing time for receipt of bids. No Bidder may withdraw their Bid after the scheduled closing time for receipt of bids.

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

6. Signing of Bids

6.1 All bids shall be signed manually, by an individual authorized to sign on behalf of the Bidder. The title or office held by the person signing for the Bidder shall appear below the signature.

6.2 A Bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the Bid form should appear as shown in the Secretary of State's records.

6.3 A Bid from a partnership or joint venture shall be signed in the name of the partnership or joint venture by at least one partner or joint venturer or by an 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 executed by all partners or joint venturers.

6.4 A Bid from a corporation shall be signed by an officer of the corporation.

6.5 A Bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

6.6 A Bid from an individual or sole proprietor shall be signed in the name of the individual by the individual or an 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

executed by the individual.

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 the Bidder's Bid including additive alternates ("Bid Security").

7.2 Bid security is required as a guarantee that the Bidder will enter into a written contract and furnish a Performance Bond within the time and in form as specified herein or in the Contract Documents; 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 forty-eight (48) hours of the Bid opening of any circumstance that may affect the Bid Security including, but not limited to, an error in the Bid. 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 Bid 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-/XL.

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 contract and Performance Bond, nor limit or fix the Bidder's liability to the Owner for any damages sustained because of failure to execute and deliver the required contract and Performance Bond.

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

8. Bidder's Statement of Qualifications

8.1 Each Bidder 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 "Bidder's Statement of Qualifications" form included with the Bid

documents.

8.2 Financial information required to be included with the Statement of Qualifications may be submitted by the Bidder in a separately sealed envelope, which will not be opened by the Owner during the public Bid opening.

8.3 The Bidder's Statement of Qualifications will be treated as confidential information by the Owner to the extent permitted by the Missouri Sunshine Law, Section 610.010, RSMo et seq.

8.4 Bids not accompanied by the 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 limited to, 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 ability of the Bidder, and their subcontractors, to handle promptly the additional work; the skill, facilities, capacity, experience, ability, responsibility, previous work, and financial standing of Bidder; the Bidder's ability to provide the required bonds and insurance; the quality, efficiency and construction of equipment proposed to be furnished; the period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified Supplier Diversity Goals or demonstrating a good faith effort to do so as described in Article 15 of this document; 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 awarded Bidder shall submit within fifteen (15) days from receipt of notice of award, the documents required in Article 9 of the General Conditions of the Contract for Construction.

10.2 No bids will be considered binding upon the Owner until all such required documents have been furnished. Failure of Contractor to execute and submit such documents within the time specified will be treated, at the option of the Owner, as a breach of the Bidder's Bid Security and the Owner shall be under no further obligation to the 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 the 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 the Contractor's faithful performance of the Contract, including but not limited to the Contractor's obligation to correct any 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 the Contract and furnishing materials in connection with the Contract in accordance with Section 107.170, RSMo. These bonds shall be in effect through the duration of the Contract plus any Guaranty Period required by the Contract Documents.

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

11.3 If the surety of any bond furnished by the 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, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If the Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

12. Time of Completion

12.1 The awarded Contractor 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 of the Contract for Construction.

13. Number of Contract Documents

13.1 The Owner will furnish the Contractor a copy of the executed contract, Performance Bond, and Payment 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

15.1.1 The Bidder shall have a minimum goal of providing participation of Diverse Firms in the project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as subcontractors, suppliers, or manufacturers, in the amount of the percent of contract price stated in the Bid Form ("Supplier Diversity Goals"). The Owner will take into consideration the Bidder's success in achieving the Supplier Diversity Goals in awarding the contract. Inability of any Bidder to meet one or more of the Supplier Diversity Goals may be cause for rejection of their Bid, unless the Bidder has demonstrated that they made a good faith effort to comply as set forth below.

15.1.2 In addition to the Supplier Diversity Goals set forth in the Bid Form, a three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Enterprises (SDVE) business doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business. The bonus preference will **not** be given to a Bidder for the use of SDVE subcontractors, suppliers, or manufacturers. The bonus preference shall be calculated and applied by reducing the Bid amount of the SDVE Bidder by three (3) percent of the apparent low, responsive Bidder's Bid. Based on this calculation, if the SDVE Bidder's resulting total Bid valuation is less than the Bid of the apparent low, responsive Bidder, the SDVE Bid becomes the apparent low, responsive Bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the SDVE Bidder's Bid or the amount(s) of any contract awarded.

15.2 List of Diverse Firms

15.2.1 The Bidder shall submit, within forty-eight (48) hours of the receipt of bids to the University Contracting Officer, a list of Diverse Firms that will be performing as contractor, subcontractor, supplier, or manufacturer on the project. The list shall separately identify each Diverse Firm by name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, supplier, or manufacturer, the Bidder shall provide information for each affected category.

15.2.2 Failure to include a complete list of Diverse Firms that will be used to meet the Supplier Diversity Goals 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 Form or elsewhere in this document.

15.3 Supplier Diversity Goal Computation

15.3.1 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 or contract and is carrying out its responsibilities by actually performing managing and supervising the work.

15.3.2 The Bidder may count toward its Supplier Diversity Goals work granted to a second or subsequent tier subcontractor that is a Diverse Firm provided the Diverse Firm assumes the actual and contractual responsibility for performing work on the project. The Bidder may count toward its Supplier Diversity Goals expenditures for materials and/or supplies obtained from a Diverse Firm, provided the Diverse Firm assumes the actual and contractual responsibility for the provision of the materials and/or supplies. To perform a commercially useful function, a supplier or manufacturer that is a Diverse Firm must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.

15.3.3 A Diverse Firm does not perform a commercially useful function if its role is solely that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which Diverse Firms do not participate.

15.3.4 A Bidder that is a certified Diverse Firm may count one hundred percent 100% of the contract amount

towards the applicable Supplier Diversity Goal(s), less any amounts awarded to another Diverse Firm. For projects with separate Supplier Diversity Goals, the Bidder will be required to obtain participation in the other categories for which it is not certified through participation by subcontractors, suppliers, or manufacturers. Therefore, an MBE Bidder is expected to obtain the required SDVE and WBE/DBE/Veteran participation; a WBE/DBE/Veteran Bidder is expected to obtain the required MBE and SDVE participation; and a SDVE Bidder is expected to obtain the required MBE and WBE/DBE/Veteran participation.

15.3.5 If the Bidder is a joint venture and the joint venture itself is certified as a Diverse Firm, the joint venture may count toward the Supplier Diversity Goals that portion of the total dollar value of the work equal to the percentage of the ownership and control of the Diverse Firm participant in the joint venture. When a Diverse Firm performs work as a participant in a joint venture where the joint venture is **not** separately certified as a Diverse Firm, only the portion of the Contract Sum equal to the distinct, clearly defined portion of the work that the Diverse Firm performs with its own forces shall count toward the Supplier Diversity Goals.

15.3.6 If a Diverse Firm is certified in more than one Supplier Diversity category, that Diverse Firm may be used to satisfy more than one Supplier Diversity goal, provided that the Diverse Firm is awarded a sufficient percentage of the contract work to meet or exceed all applicable Supplier Diversity Goals.

15.4 Certification of Diverse Firms

15.4.1 The Bidder shall submit, within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer, the information requested in the "Supplier Diversity Compliance Evaluation Form" for every Diverse Firm the Bidder intends to award work to under the contract to meet the Supplier Diversity Goals.

15.4.2 "Diverse Firm" is defined in Article 1 of the General Conditions of the Contract for Construction. The Bidder is responsible for obtaining information regarding the certification status of a Diverse Firm. A list of certified Diverse Firms may be obtained by contacting the agencies listed in the document entitled "Supplier Diversity Certifying Agencies."

15.4.3 Bidders are urged to encourage their prospective subcontractors, joint venture participants, team partners, suppliers and manufacturers who are Diverse Firms but are not currently certified to obtain certification from one of the approved agencies prior to

bidding.

15.5 Supplier Diversity Participation Waiver

15.5.1 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 Supplier Diversity Participation and has failed, the Bidder shall submit within forty-eight (48) hours of the time for receipt of bids to the University Contracting Officer, 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 Supplier Diversity Goal(s). If the Bidder is judged not to have made a good faith effort, the Bid may be rejected. Bidders who demonstrate that they have made a good faith effort to meet the Supplier Diversity Goal(s) may be awarded the contract regardless of the actual percent of Supplier Diversity Participation, provided that the Bid is otherwise acceptable and is determined to be the lowest, responsive, responsible Bid.

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

15.5.2.1 The Bidder's attendance at pre-proposal meetings scheduled to inform Diverse Firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity Participation.

15.5.2.2 The Bidder's advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

15.5.2.3 The Bidder's written notice to specific Diverse Firms that their services were being solicited in sufficient time to allow for their effective participation.

15.5.2.4 The Bidder's follow-up attempts to the initial solicitation(s) to determine with certainty whether Diverse Firms were interested.

15.5.2.5 The Bidder's efforts to divide the work into packages suitable for subcontracting to Diverse Firms.

15.5.2.6 The Bidder's efforts to provide interested Diverse Firms with sufficiently detailed information about the Drawings, Specifications and requirements of the contract, and clear scopes of work for the Diverse Firms to bid on.

15.5.2.7 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 Diverse Firms contacted, a description of all information provided to the Diverse Firms, and an explanation as to why agreements were not reached.

15.5.2.8 The Bidder's efforts to locate Diverse Firms not on the directory list and assist Diverse Firms in becoming certified as such.

15.5.2.9 The Bidder's initiatives to encourage and develop participation by Diverse Firms.

15.5.2.10 The Bidder's efforts to help Diverse Firms overcome legal or other barriers impeding the participation of Diverse Firms in the construction contract.

15.5.2.11 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.

15.6 Submittal of Forms

15.6.1 Within forty-eight (48) hours of the time for receipt of bids, the apparent low Bidder shall submit to the University Contracting Officer all Supplier Diversity Compliance Evaluation Form(s), and/or Application for Waiver with supporting information, and an "Affidavit of Supplier Diversity Participation" for every Diverse Firm the Bidder intends to award work on the contract. The affidavit will be signed by both the Bidder and the Diverse Firm. Failure to submit the documents in the time indicated may result in rejection of the Bid.

15.7 Additional Bid/Proposer Information

15.7.1 The Contracting Officer reserves the right to request from the apparent low Bidder additional information regarding the Bidder's proposed Supplier Diversity Participation and supporting documentation. The Bidder shall respond in writing to the Contracting Officer within twenty-four (24) hours of a request.

15.7.2 The Contracting Officer reserves the right to request additional information after the Bidder has responded to prior requests. This information may include follow up and/or clarification of the information previously submitted.

15.7.3 The Owner reserves the right to consider additional Supplier Diversity Participation submitted by the Bidder after bids are opened. The Owner may

elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity Goal.

15.7.4 The Bidder shall provide to the Owner information related to the Supplier Diversity Participation included in the Bidder's proposal, including, but not limited to, the complete Application for Waiver, evidence of certification of participating Diverse firms, dollar amount of participation of Diverse Firms, information supporting a good faith effort as described above, and a list of all Diverse Firms that submitted bids to the Bidder with the Diverse Firm's price, and the name and the price of the firm awarded the scope of work.

16. List of Subcontractors

16.1 If a list of subcontractors is required on the Bid Form, the Bidder shall list the name, city, and state of the firm(s) that 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 Section 15.2 and the complete list of subcontractors required in Section 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 forty-eight (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 errors in the Bid, a listed subcontractor's inability to perform the work, etc. Any request to change a listed subcontractor shall include at a minimum, a 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 herein and Article 5 of the General Conditions of the Contract for Construction will apply.

University of Missouri

General Conditions

of the

Contract

for

Construction

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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 Owner is The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof. The Owner may also be referred to herein as "University".

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 Owner's Authorized Agent

When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

1.1.6 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.

1.1.7 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

performed 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.

1.1.8 Diversity Definitions

"Diverse Firm" shall mean an approved, certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse individuals 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 Marianas.

.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 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 DBEs 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 the 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”, “compliant”, “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(s) of the Project by the Owner’s Representative or the Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or the Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

1.1.20 Force Majeure

An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

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 be 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 the 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 departure for the approval by the Owner’s Representative and the 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 the 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. The 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 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's Representative may order the Contractor 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. The Owner's lifting of Stop Work Order shall not prejudice the 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, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. 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 surety. In such case, the 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 the Owner.

2.4 Extent of Owner Rights

2.4.1 The rights stated in 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 all actions 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, Regulations, Permits, Codes, and Inspections

3.2.1 The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (which may be 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.

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 the 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, corporation, or joint venture or other business entity, 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 3.18 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 benchmark 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. The 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 the Contractor to comply with the provisions of this Paragraph shall cause the Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by the 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** The 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 the 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 workday 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 the 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 the Contractor's 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 the Contractor.

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 or inspection 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 other entity or 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 the 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 compliant and 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, the 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, the 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. The 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 the 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 the Owner and shall at once report in writing to the Architect and the 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 the 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 the Owner's Representative within twenty-four (24) hours. During the progress of the Work, the Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. The 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 the Owner's Representative and the Architect. The 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 Contractor's own expense, but only as directed by the Architect, through the Owner's 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 six (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 and code 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, the Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. The 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, the 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 the 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, the 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 the 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 the Contractor refuses to assume or perform, or delays in assuming or performing the 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 the Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which the Contractor is obligated to indemnify the Indemnitees from under this Paragraph, the Contractor shall remain liable for all costs of defense.

3.9.2 The indemnity obligations of the 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. The Owner reserves the right to control the defense and settlement of any claim, action or proceeding which the Contractor has an obligation to indemnify the Indemnitees against.

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 damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.9.4 The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, the Architect's 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, the Contractor 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 include, 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 Delegated Design

3.11.1 If the Contract Documents specify the Contractor is responsible for the design of any Work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

3.12 Materials, Labor, and Workmanship

3.12.1 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.

3.12.2 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.

3.12.3 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.

3.12.4 The Contractor shall base its bid only on the Contract Documents.

3.12.5 Materials and workmanship shall be subject to inspection, examination, and testing 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.

3.12.6 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.

3.12.7 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.

3.12.8 Substitutions

3.12.8.1 A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.13.

3.12.8.2 The 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 Document requirements and is code compliant, 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 the Owner's Representative in sufficient time to allow the Architect and the Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

3.12.8.3 Substitutions may be rejected without explanation at the 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.

3.12.8.4 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 substitution.

3.13 Approved Equal

3.13.1 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 and is code compliant.

3.13.2 The Contractor shall submit to the Architect and the 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 the 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.

3.13.3 No approvals or action taken by the Architect or Owner's Representative shall relieve the Contractor from its obligation to ensure that an "or equal" article, appliance, devise, or material strictly complies with the requirements of the Contract Documents. The Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and the 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 the 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.

3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models

3.14.1 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.

3.14.2 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.

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

3.14.4 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.

3.14.5 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.

3.14.6 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 ninety (90) days of the Notice to Proceed. If the Contractor believes that this milestone is unreasonable for any submittal, the Contractor shall request an extension of this milestone, within sixty (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 ninety (90)-day milestone is unrealistic and shall specify a date on which the submittal will be provided, 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.

3.14.7 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 the Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that the Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by the Architect and in such event, the Contractor shall immediately remove all such materials from the Work site. When requested by the Architect or the 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.

3.14.8 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.

3.14.9 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. The Contractor shall also coordinate each Submittal with other Submittals.

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

3.14.11 Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and the Contractor has satisfied its obligations under the Contract Documents with respect to the Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of the 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.

3.14.12 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, the

Contractor acknowledges that the Architect's approval of Shop Drawings shall not relieve the Contractor for responsibility for errors and omissions in the Shop Drawings since the Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

3.14.13 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.

3.14.14 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.

3.15 Record Drawings

3.15.1 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 the Owner or the Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by the Architect to the Contractor at the start of construction. Upon Substantial Completion of the Work, the Contractor shall deliver all Record Drawings to the Owner and the Architect for approval. If not approved, the Contractor shall make the revisions requested by the Architect or the Owner's Representative. Final payment and any retainage shall not be due and owing to the Contractor until the final Record Drawings marked by the Contractor as required above are delivered to the Owner.

3.16 Operating Instructions and Service Manuals

3.16.1 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.

.4.1 Recommended spare parts including catalog number and name of local suppliers or factory representative.

.4.2 Belt sizes, types, and lengths.

.4.3 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.

3.16.2 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.

3.17 Taxes

3.17.1 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 Section 144.062, RSMo. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of Section 144.062, RSMo.

3.17.2 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.

3.17.3 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.

3.17.4 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, the Owner shall be liable for the tax owed.

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

3.18 Contractor's Construction Schedules

3.18.1 The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and the Architect's information the 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.

3.18.2 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 the 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.

3.18.3 As time is of the essence to this Contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this Contract. At a minimum, the 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, the 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 schedule 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.

3.18.4 In the event the Owner's Representative or the 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 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. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph 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. The Contractor shall be obligated to promptly proceed with such work. If the Contractor feels that it is entitled to additional compensation as a result of a Construction Directive, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Contract.

4.1.4 The Owner's Representative, may, by written notice, require the Contractor to remove from involvement with the Work, any of the 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. The

Contractor shall provide Owner's Representative a copy of such written request.

4.3 Review of the Work

4.3.1 The Architect, the Owner's Representative, and the Owner's Authorized Agent 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 the 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 the 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 rescission. Claims must be made by written notice. The Contractor shall have the responsibility to substantiate Claims.

4.4.2 Claims by the 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 the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. The 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. The Contractor shall furnish the Owner and the 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 the 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 so 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, the 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 the 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 other requirements for notice of a Claim, the 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 (4) working 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 Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contractual obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contractual obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the Contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the Contract Time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the Contract requirements. The Owner will provide a Change Order extending the time for contract completion or direct an acceleration of the

Work in accordance with the Contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

4.7.3 A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays, which are administered under Article 4, and notwithstanding other requirements of the Contract, all Force Majeure events resulting in a delay to the critical path of the project shall be administered as provided in Article 8.

4.7.4 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.

4.8 Resolution of Claims and Disputes

4.8.1 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.

4.8.2 If a Claim has not been resolved, the Contractor shall, within ten (10) 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.

4.8.3 If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

4.9 Administrative Review

4.9.1 Claims not 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.

4.9.2 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 Contractor and Owner'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.

4.9.3 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, [in care of the Executive Director of Facilities Planning and Development, University of Missouri, 130 General Services Building, 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. The Contractor and the 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. The Contractor agrees not to file any

complaint, petition, lawsuit or legal proceeding against the 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, the 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 the Contractor's work at the proper time. Each Contractor shall be required to coordinate the Contractor's work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, 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 the Owner's or another Contractor's property done by the Contractor or the Contractor's employees, 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 the Contractor's 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 the 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, the 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 Order Requests not yet finalized.

.3 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 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 the 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). The 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, the Contractor shall promptly proceed with the change in the Work involved and advise the Owner of the 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, expeditors, 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 the Contractor's 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. The 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 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 the 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 Contractor's 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, the 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 The Contractor acknowledges and agrees that time is of the essence of this Contract.

8.1.2 The 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 elsewhere 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, the Contractor shall be liable for such liquidated damages as set forth in Section 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, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, 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) justifying the delay 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 the 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 of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that the Contractor provides 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. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the Contract Time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the Contract Sum for any reason shall be allowed due to a Force Majeure.

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 the 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 claims due to or caused by any events beyond the control of both the Owner and the Contractor defined herein as Force Majeure. 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 the Contractor or by acts or omissions of the Contractor or its Subcontractors of any tier or delays beyond the control of both the Owner and the 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, the Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. The 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, but in no case shall Force Majeure be the basis of an increase in the Contract Sum. 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, the Contractor shall only be entitled to its actual direct costs caused thereby and the 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 the 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 the 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 the 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 the Contractor's 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. The 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)

9.1.4 In the event the Contractor fails to provide the Owner such documents, the 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 the Contractor access to the site as a result of the Contractor's failure to provide such documents and the Contractor shall not be entitled to an adjustment of the Contract Time or Contract Sum as a result of its failure to provide the Owner the required documents

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 word "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 the Contractor represent and warrant that the person signing the Contract has the legal authority to bind the 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 the Owner.
- .5** Itemized breakdown of anticipated equipment rates (breakout 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. The 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). The 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 the 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 the 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 the 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. The 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 the 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 Contract, offsite is defined as any location not owned or leased by the Owner. The Contractor shall submit a list of materials that they are requesting payment for offsite storage within sixty (60) days of Notice to 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 The 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 (45) 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. The 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' notice 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 a Bill of Sale on forms provided by the Owner's Representative, 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.

.11 The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.

.12 The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner's Representative.

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 to the 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 or non-compliant 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, the 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 the Contractor;
- .8 The Contractor's failure to comply with applicable laws;
- .9 The Contractor's or Subcontractor's failure to comply with applicable wage requirements; or
- .10 The 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 the Contractor for amounts due and approved by the 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 the Contractor, Applications for Payment submitted by the Contractor shall indicate the actual percentage of completion of each portion of the 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 the 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 the 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 the Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by the 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 the 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 1.1.14 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 the 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 the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, 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 the 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 the 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, the Owner's Representative will return the Contractor's Final Application for Payment to the 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 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 the Contractor of its final payment, by check or electronic transfer, shall be and operate as a release of all claims of the Contractor against the Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of the 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 the Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and the 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 the 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 The Contractor and all Subcontractors to the Contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, unless they have previously completed the program and have documentation of having done so. The Contractor will forfeit a penalty to the Owner of \$2,500 plus an additional \$100 for each employee employed by the Contractor or Subcontractor, for each calendar day, or

portion thereof, such employee is employed without the required training.” (Section 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 the 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, standards, codes, 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 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 the 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 the Architect. The Contractor shall hold regularly scheduled safety meetings to instruct the Contractor’s 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 its employees and its 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.

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 AND BONDS

11.1 Insurance

11.1.1 The 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 the Contractor, the 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 the Owner, but, regardless of such approval, it shall be the responsibility of the Contractor to maintain the insurance coverages set forth herein.

11.1.2 The Contractor shall not be allowed on the Owner's property without proof of the insurance coverages set forth herein

11.2 Commercial General Liability

11.2.1 The Contractor shall secure and maintain from the date of the Contract, and for a period of at least ten (10) 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 must apply per project. An umbrella policy may be used to satisfy these limits.

11.2.2 CGL insurance shall be written on a Commercial form CG 00 01 or an equivalent form providing the same coverages 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.

11.2.6 The Contractor waives all rights against the 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 The 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 the 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 The Contractor waives all rights against the 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 The Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect the Contractor from claims for injury, sickness, disease or death of the 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 subcontracted, the Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Paragraph.

11.4.2 The Contractor's workers' compensation insurance coverage shall be in compliance with all applicable laws, including the statutes of the State of Missouri. The 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 General Insurance Requirements and Professional Liability

11.5.1 Any Consultant/Contractor providing professional design services as part of the Contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance, in a claims made form, to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the design and related services performed by the Consultant. The minimum limits for such policy shall be \$1,000,000.00 per claim/\$1,000,000.00 aggregate.

11.5.2 "The officers, employees, and agents of The Curators of the University of Missouri" shall be added as Additional Insured with respect to the CGL, umbrella/excess and Automobile Liability policies required herein. A certificate of insurance evidencing all coverage required is to be provided at least ten (10) days prior to the inception date of the Contract between the Contractor and the University. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The University reserves the right to require higher limits on any contract provided notice of such requirement is stated in the request for proposals for such contract. The Contractor shall request that its insurer(s)

include the following disclaimer in any insurance policy, rider or endorsement issued pursuant to this Additional Insured requirement: "Neither the requirement for Additional Insured status nor any of the Contractor's action in compliance with such requirement, either direct or indirect, is intended to be and neither shall be construed as a waiver of any sovereign immunity, governmental immunity or any other type of immunity enjoyed by The Curators of the University of Missouri, the Board of Curators of the University of Missouri, or any of its officers, employees or agents."

The Additional Insured status must be conveyed by using the ISO CG 20 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.

11.5.3 All insurance coverages procured by the Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. All insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier, except that the Professional Liability insurance required herein may be provided by any insurance company legally authorized to do business in the State of Missouri. The form and content of all insurance coverage provided by the Contractor are subject to the approval of the Owner. All required insurance coverages shall be obtained and paid for by the Contractor. Any approval of the form, content or insurance company by the Owner shall not relieve the Contractor from the obligation to provide the coverages required herein. All insurance coverage 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 the Contractor covering the Additional Insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.4 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. The Contractor shall cause its insurance carriers for all required coverages, except for workers' compensation, to waive all rights of subrogation against the Owner and its officers, employees and agents.

11.5.5 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. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The 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.

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

11.5.7 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 the Contractor's exercise or enforcement of any rights under the Contract Documents.

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

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

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

11.5.11 By requiring the insurance set forth herein and in the Contract Documents, the Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect the Contractor, and such coverages and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner in the Contract Documents. For those policies requiring the Owner to be added as an

Additional Insured, as set forth herein, the Owner and all other indemnified parties shall be an Additional Insured for the full limits carried by the Contractor, not just the limits required herein.

11.5.12 If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

11.5.13 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; 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.

11.5.14 It is understood and agreed that the insurance coverages required by the provisions of this Contract are required in the public interest and that the Owner does not assume any liability for acts of the 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, the 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 the 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. 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, lightening, earthquake, flood, frost, water damage, windstorm and freezing.

11.6.5 If there are any deductibles applicable to the insurance required herein, the 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 the Owner to the 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 the 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 or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or the 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 the 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 Subcontractors in similar manner. The Contractor shall waive its rights to subrogation for any loss or damage to the Contractor's property or equipment coverage in favor of the Owner and other indemnified parties.

11.7 Bonds

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 the Contractor's faithful performance of this Contract, including but not limited to the 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 the 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 Section, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of the Contractor at the 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 the 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 The 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 the 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, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall 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 the 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 the Architect or the Owner's Representative, the Architect or the 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." The Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant 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 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 The 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 the 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, codes, 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, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, the Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made

so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

13.3.2 If the Architect, the Owner's Representative, or the Owner's Authorized Agent 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, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent, may choose that the tests or inspections can be performed or observed. 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 and Owner's Authorized Agent'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 the Architect.

13.3.5 The 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 The 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 the Architect or the Owner with a reasonable belief that additional defective Work may be found, in which case the Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or the Architect, whether or not such tests or inspection 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 and/or receives funds from the United States

government. Accordingly, the Contractor shall comply with applicable federal laws, rules, and regulations, including those relating to nondiscrimination, equal employment opportunity, and affirmative action in the employment of certain entities or individuals, including, but not limited to, 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]), and those related to contracting with small or disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Federal Government in such circumstances are incorporated herein by reference.

13.4.2 If applicable, the Contractor shall comply with the equal opportunity requirements of 41 CFR Part 60, which are incorporated into this Contract by reference.

13.5 Supplier Diversity Participation Goals

13.5.1 The Contractor shall provide participation of Diverse Firms in the Project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as Subcontractors, suppliers or manufacturers, in an amount that is no less than the percent of Contract Sum that was promised in the Contractor's bid and/or the amount accepted by the Owner.

13.5.2 If the Contractor must remove any Diverse Firm as a Subcontractor, supplier or manufacturer under the Contract, the Contractor shall replace the Diverse Firm with one or more Diverse Firms in an amount equal to the dollar value of the work awarded to the Diverse Firm that was removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any Diverse Firm as a Subcontractor, supplier or manufacturer, and the Contractor's plan to provide the promised amount of Supplier Diversity Participation. All changes of a Diverse Firm as a Subcontractor of any tier, supplier or manufacturer under the Contract shall be approved by the Executive Director of Facilities Planning and Development.

13.5.3 If the Contractor fails to meet or to maintain the promised amount of Supplier Diversity Participation, the Contractor shall immediately notify in writing the Owner's Representative and the Executive Director of Facilities Planning and Development. Such notice shall include a description of the Contractor's good faith effort to provide the promised Supplier Diversity Participation.

13.5.4 If the Executive Director of Facilities Planning and Development finds that the Contractor has failed to comply in good faith with the promised Supplier Diversity Participation the Executive 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 Executive Director of Facilities Planning and 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 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 the non-discrimination requirements in Section 13.4 and 13.5, 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 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 adjustments that increase the Contract cost above \$75,000 will be subject to this Section, per Section 290.230, RSMo.)

13.6.1 The Contractor and its Subcontractors shall pay all workers performing work under the Contract not less than the prevailing hourly rate of wages or the public works contracting minimum wage, whichever is applicable, as set out in the Annual Wage Order that is attached to and made part of the specifications for work under the Contract, in accordance with Sections 290.210 to 290.340, RSMo

(Missouri Prevailing Wage Law) and related regulations. The Annual Wage Order(s) published by the Missouri Department of Labor and Industrial Relations (MDLIR) for the location where the Work is performed is incorporated into the Contract by this reference. The Contractor shall use applicable MDLIR regulations, including, but not limited to, 8 CSR 30-3.010-3.060, 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 Executive Director of Facilities Planning and Development.

13.6.2 If this Project is financed in whole or in part from Federal funds (as indicated in the bid or Contract Documents), then this Contract shall be subject to all applicable federal labor statutes, rules, and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. § 3141 et seq., and the "Federal Labor Standards Provisions." Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this Contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

13.6.3 The Contractor will forfeit a penalty to the Owner of \$100 per day (or portion of a day) for each worker that is paid less than the specified rate for any work done under the Contract by the Contractor or by any Subcontractor. The Owner shall deduct from any unpaid amounts then or thereafter due the Contractor under the Contract all sums and amounts due and owing as a result of any violation of Sections 290.210 to 290.340, RSMo. (Section 290.250, RSMo) The Contractor agrees to abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as penalties for underpayment of wages.

13.6.4 The prevailing wage rate(s) and public works contracting minimum wage(s) included in the Annual Wage Order(s) include fringe benefits as set forth in Sections 290.219 and 290.257, RSMo. 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 Section 290.210(5), RSMo.

13.6.5 The Contractor shall make full payment of the applicable required wages to workers in legal tender. 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 as fair and reasonable in accordance with Section 290.315, RSMo.

13.6.6 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. Do not include personal social security numbers in payroll records. 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 records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within ten (10) days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within twenty-four (24) hours of written notice. Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. Falsification of the certified payroll records may result in the debarment of the Contractor or Subcontractor from future work with the University.

13.6.7 If applicable, the Contractor shall comply with the Copeland "Anti-Kick Act, 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

13.6.8 The Contractor shall specifically incorporate the obligations of Section 13.6 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

13.6.9 If Contractor fails to comply with the provisions of Section 13.6 of this Contract or with Sections 290.210 to 290.340, RSMo and related regulations, the Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of the Owner provided herein shall not be exclusive and are in addition

to other rights and remedies provided by law or under this Contract.

13.6.10 The Contractor may pay entry-level workers or federally-registered apprentices fifty percent (50%) of the pay of a journeyman in their same occupational title, in accordance with Section 290.235, RSMo and 8 CSR 30-3.030. Per 8 CSR 30-3.030, an entry-level worker is "[a]ny worker who is not a journeyman and who is not otherwise enrolled in a federally-registered apprenticeship program but is participating in an on-the-job training program provided by the contractor for whom they perform work on a public construction project." The University of Missouri may require documentation showing, to the University's sole satisfaction, that an entry-level worker is participating in an on-the-job training program with the Contractor. The combined total of such entry-level workers and federally registered apprentices shall not exceed a one-to-one ratio with the number of journeyman workers in any occupational title on the project.

13.6.11 The Contractor shall post the wage rates for the Contract in a dry, accessible place at the field office on the project or, where there is no field office, at the Contractor's local office or batch plant so long as a copy is provided to workers upon request, as required by 8 CSR 30-3.050. The wage rates shall be kept in a clearly legible condition for the duration of the project.

13.6.12 Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request, demand or receive, either before or after such worker is engaged, that such worker pay back, return, donate, contribute, or give any part or all of said worker's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment, and no person shall, directly or indirectly, pay, request or authorize any other person to violate this Section as set forth in Section 290.305, RSMo, 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. 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 applicable wage rate as provided in the 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.

13.6.13 The Contractor will pay workers overtime for all hours worked over ten (10) hours per day and forty (40) hours per week in accordance with Section 290.230, RSMo. For all overtime work performed, not less than one and one-half the prevailing hourly rate of wages for work of a similar character

in the locality in which the Work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid. 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 in accordance with Section 290.230, RSMo. For purposes of this Section, 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.

13.7Records

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.

13.8Codes 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** ICC International Fire Code
- .5** ICC International Fuel Gas Code
- .6** NFPA 70 National Electric Code (NEC)
- .7** Americans with Disabilities Act – Standards for Accessible Design.
- .8** American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1
- .9** NFPA 101 Life Safety Code (as noted above)
- .10** American Concrete Institute (ACI)
- .11** American National Standards Institute (ANSI)
- .12** American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- .13** American Refrigeration Institute (ARI)
- .14** American Society for Testing and Materials (ASTM)
- .15** Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
- .16** National Electrical Manufacturers Association (NEMA)
- .17** Underwriter's Laboratories, Inc. (UL), Federal Specifications
- .18** 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. The Contractor and the Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

13.9.3 The Contractor and the 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 the Contractor and the Owner. The Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against the Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

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

13.9.5 The Contractor agrees that the Owner shall not be liable to the Contractor for any special, indirect, incidental, or

consequential damage whatsoever, whether caused by the 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. The 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 the 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. The Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If the Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and the Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon the 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 Certifications

13.10.1 Suspension and Debarment

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 department or agency in accordance with Federal Executive Orders 12549 (2/18/86) and 12689 (8/15/89).

13.10.2 Anti-Discrimination Against Israel Act

If this Contract is for \$100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it, does not boycott Israel, and will not boycott Israel during the term of this Contract. In this Paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

13.10.3 Byrd Anti-Lobbying Amendment

.1 If this Contract exceeds \$100,000 and is funded by Federal funding, Contractor agrees to file the required certification, in compliance with 31 U.S.C. § 1352 (as amended).

.2 Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352.

.3 Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

13.10.4 Work Authorization

The Contractor and all subcontractors performing work under this Contract shall enroll and participate in a federal work authorization program operated by the United States Department of Homeland Security, E-Verify or an equivalent federal work authorization program, to verify information of newly hired employees, under the Immigration Reform and Control Act of 1986 (IRCA), P.L.99-603. By executing a contract with The Curators of the University of Missouri, the Contractor shall affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted service and affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. The Contractor shall maintain documentation of its participation in a federal work authorization program and make such documentation available to the University upon request.

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 the 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, codes, regulations or orders of an authority having jurisdiction;

.5 disregards the authority of the Owner's Representative, the Architect, or the Owner's Authorized Agent;

.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 the Contractor and the 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 Section 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 the 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 Section 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 Section 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 Section 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Section 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 14.3.

SECTION 1.E

SPECIAL CONDITIONS

1. DEFINITIONS

a. “Drawings”

Drawings referred to in and accompany Project Manual consist of Drawings prepared by and bearing the name of the below defined Architect, bearing Date of 7/8/25, entitled “CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT”, project number CP252301.

b. Mechanical, Plumbing, & Electrical Engineer
SSC Engineering
18207 Edison Ave.
Chesterfield, MO 63005
(636)530-7770

c. Architect
Lawrence Group
319 N. 4th Street, Suite 1000
St. Louis, MO 63102
(314)231-5700

d. Civil Engineer
Crockett Engineering Consultants
1000 W. Nifong Blvd, Building 1
Columbia, MO 65203
(573)447-0292

e. Other Definitions: See Article 1., General Conditions

2. SPECIAL SCHEDULING REQUIREMENTS

a. Special scheduling requirements supplemental to the bid form

Contractor shall perform all work in the designated areas outside of regular working hours, which are **8:00** a.m. to **5:00** p.m., Monday through Friday.

Contractor shall notify the client of all proposed outages and coordinate with the facility 14 days prior to an outage.

Contractor shall provide submittals of electrical equipment including, panelboards, switchgear, switchboards, and transformers within 14 days of notice to proceed.

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 the 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 installation of new switchgear and upgrades to electrical distribution system including switchgear, switchboards, transformers, panelboards, and automatic transfer switches.
 - (2) Demolition shall consist of demolition of existing electrical switchgear, switchboards, transformers, and automatic transfer switches to be replaced; demolition of existing conditions in new electrical space interfering with new equipment to be installed.
 - (3) Architectural work shall consist of removal of ceiling, finishing, installation of new doors, concrete, and firestopping of penetrations in and around new electrical space.
 - (4) Plumbing work shall consist of replacement of cast iron waste and vent piping, and installation of new plumbing in new electrical space.
 - (5) Mechanical work shall consist of upgrades to air distribution system for new electrical space.
 - (6) Electrical work shall consist of installation of new electrical switchgear, transformers, automatic transfer switches, switchboards, and panelboard for electrical distribution system upgrades; coordination with facility for all outages.

4. LOCATION

- a. Work shall be performed under this Contract on the campus of the University of Missouri – Healthcare, at Capital Region Medical Center in Jefferson City, MO.

5. NUMBER OF CONSTRUCTION DOCUMENTS

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

- b. The contractor may obtain printed sets from the architect at cost of reproduction.
- c. The Owner will furnish explanatory and changed Drawings to the Contractor in PDF format as issued during project.
- d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the reference project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:
 - (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
 - (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.
 - (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
 - (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
 - (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.

- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

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. 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 Locations
 - (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.4) for the required submittal information.
- d. The Contractor shall submit to the Architect four (4) bound copies 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.5).

- e. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.6) 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. USE OF PREMISES

- a. Access: Access to construction site shall be as indicated on the drawings and as directed by the Owner's Representative.
- b. Parking: Contractor shall be issued parking permits for ten (10) service vehicles to park in the **South side of employee parking lot J** location directed by the Owner's Representative. Employee parking shall be on public streets or were directed by the Owner's Representative. The contractor parking lot (if available), may also be utilized for employee parking.
 - (1) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.
- 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. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost at the South side of employee parking lot J or in alternate parking lot Q.
- 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. Smoking 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 or marijuana products, including e-cigarettes, cigarettes, and vaping.

- g. 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.
- h. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- i. Artifacts Found During Construction: Contractor shall immediately notify the Owner's Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.

k. **“Permit Required Confined Space” Entry Communication and Coordination**

(See OSHA 1926 subpart aa – Construction Confined Space for the definition of “permit required confined spaces” - Note: OSHA does not apply to the University. However, the University will provide a list of all known “permit required confined spaces”)

There are no known “permit required confined spaces” within the project limits. Each contractor shall conduct a survey to confirm whether or not any confined spaces exist within the project limits. It is incumbent upon each contractor to list all “permit required spaces”.

The Contractor shall notify the Owner's Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a “permit required confined space” after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a “permit required confined space”; or 3) during the course of construction a “permit required confined space” is created after evaluation by a competent person.

The Contractor shall submit to the Owner's Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

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. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

b. Construction Project Fencing:

- (1) Fencing requirements, as indicated on Drawings, shall be constructed of 9 or 11-gauge chain link not less than six (6) feet in height and not more than 2-inch mesh with posts spaced not more than ten (10) feet apart and all corner and gate posts imbedded in concrete. All other posts shall be sufficiently secured in ground to maintain proper and adequate support of fence. Fenced in area shall have at least two (2) access gates and all gates shall be lockable.
- (2) Fencing requirements, as indicated on Drawings and/or described in Specifications and where necessary to protect public and Owner's property shall be constructed of woven wire or plastic woven fencing not less than five (5) feet in height and supported by metal tee posts anchored securely in ground at not more than ten (10) foot intervals.
- (3) 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.
- (4) 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.
- (5) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (6) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (7) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

c. Preserving and Protecting Existing Vegetation:

(1) Protection and compensation for damages:

- (a) Trees and shrubs within work area designated to remain shall be protected from damage during construction by fixed chain link fencing or armoring as indicated on Drawings or specified herein. Plant protection devices shall be installed before work has begun and shall be maintained for duration of work unless otherwise directed by Owner's Representative.
- (b) In the event that damage(s) to the Owner's trees, shrubs or vegetation occurs as a result of the Contractor's unauthorized operations, the Contractor shall pay or allow to the Owner compensation for said damage(s). Compensation shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

- (2) To prevent compaction of soil over tree roots, vehicles or equipment shall not at any time park or travel over, nor shall any materials be stored within drip line of trees designated to remain.
- (3) Only minimal grading or disturbance will be allowed to area within and adjacent to drip line of trees or shrubs designated to remain. Contractor shall obtain approval from Owner's Representative prior to starting any grading work in these areas. Unnecessary cutting of plant roots shall not be permitted. The Contractor shall stop work immediately and shall notify Owner's Representative immediately if root system is exposed or if any roots over 1 1/2" in diameter are encountered. Roots exposed and/or damaged during construction shall be immediately cut off cleanly behind exposed or damaged area, and cut surface treated in accordance with established horticultural standards and covered with topsoil.
- (4) Owner's Representative will stop work immediately when proper measures are not being employed to protect trees and shrubs. Contractor will be notified to resume work after required protection measures are implemented.
- (5) Contractor shall repair tire ruts and other damages to existing lawn areas. Repairs shall match surrounding area.

10. SUBSTITUTIONS AND EQUALS

- a. Substitutions and equals are defined in Article 3 of the General Conditions.

- 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 of any item described in the Contract Documents will be allowed only prior to the receipt of bids provided that a request for approval has been 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.
- b. 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:

<u>Item</u>	<u>Specification Section</u>
ASCO Automatic Transfer Switches	260620

11. CODES AND STANDARDS

- a. The Contractor shall comply with applicable codes and standards as listed in the General Conditions.

12. PERMITS

- a. 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 except as noted in Article 3.2 of the General Conditions.

13. SPECIALTIES

- a. Irrigation System: Modifications(s) to existing systems is to match the existing equipment and materials. The Owner will provide to the contractor the product information on the existing irrigation systems so the correct changes and/or repairs can be made.
- b. Road closure shall be coordinated with the Owner to notify the appropriate EMS and hospital staff. 14 calendar days prior notice shall be provided prior to scheduling road closures.

14. PRE-BID INSPECTION

- a. All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-6800

15. MODIFICATIONS TO INFORMATION TO BIDDERS

- a. Information to Bidders:
 - (1) Referenced Information to Bidders, Page IFB/5.
Add new Article 15.8.5 as follows:

15.8.5 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.

16. MODIFICATIONS TO GENERAL CONDITIONS

- a. General Conditions
 - (1) Add to the Insurance Requirements in General Conditions Article 11, Pollution Liability Coverage, for specified hazardous waste disposal in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Hazardous Waste Disposal Subcontractor and/or Hauler in lieu of the General Contractor subject to all requirements set forth in article 11.

17. PROJECT SCHEDULING

- a. Contractor Schedule – Contractor is responsible for the schedule, that may be provided with in-house personnel or hired a third-party scheduling consultant. See Contractor Schedule Requirements included in these documents.
- b. Contractor Schedule Requirements
 - (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 to that the critical milestone and end dates spelled out in the contract are achieved.

(b) Related Documents

- (i) Drawings and general provisions of the Contract, including General Conditions' Article 3.18 shall apply to this Section.

(c) Stakeholders

- (i) A Stake holder 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 Subcontractor(s).

(d) Weather

- (i) Contractor acknowledges that there will be days in which work cannot be completed on weather sensitive activities, due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
- (ii) 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, on weather sensitive activities of critical path work, 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.
- (iii) 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

- (iv) The Contractor shall notify the Owner's Representative via email on the same day a lost weather day occurs and shall maintain a log of weather days to be included in the Narrative described in 2.3.4 herein.

(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

(i) Schedule Development

Contractor shall prepare the Project Schedule using the latest version of Phoenix Project Management scheduling software or other software as approved by the Owner's Representative prior to receipt of bids.

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.

(ii) Schedule Updates

1. Schedule Updates will be conducted once a month, at a minimum. Actual Start and Finish dates should be recorded regularly during the month. Remaining Duration shall be updated as of the data date, just prior to Contractor's submittal of the updated data.
2. Contractor will copy the previous months schedule and will input update information into the new monthly update version.
3. 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:
 - (a) Review out of sequence progress, making adjustments as necessary.

- (b) Add any fragnets necessary to describe changes or other impacts to the project schedule and
 - (c) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(b) 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.

(c) Progress Meetings

- (i) 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.
- (ii) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include four (4) weeks 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 pay 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)(iii), 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.
 - (i) Phasing: Provide activity codes in the schedule to show how the sequence of the Work is affected by the following:
 1. Requirements for phased completion and milestone dates.
 2. Work by separate contractors.
 3. Work by the Owner
 4. Coordination with existing construction.
 5. Limitations of continued occupancies.
 6. Uninterruptible services.
 7. Partial occupancy prior to Substantial Completion.

8. Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of the Article, a “major area” is a story of construction, a separate building, or a similar significant construction element.
9. Required delivery dates for Owner furnished equipment, if applicable
10. Post substantial completion activities and closeout
11. Floor or Level: Use separate activity codes to identify each floor or level.
12. Subcontractor: Use Activity Codes to identify each subcontractor’s work activities.
13. Type Work or Craft: Use Activity Codes to identify the type of work, or craft that will execute each activity.

(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:
 - (i) An activity depicting the event(s) impacting the Contractor’s work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
 - (ii) 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.
 1. If the adjustments above 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.
 2. 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 allocated 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 may be considered for equitable adjustment. In review of time extension requests for compensable days, the Owner will consider the actual number of weather days incurred.
- (d) Home office expenditures and staff are NOT compensable.

18. BUILDING SYSTEM COMMISSIONING

- a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log. Contractor shall use all MU forms for commissioning which can be found at <https://operations.missouri.edu/facilities/commissioning-forms>
- b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as applicable.

19. 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.

- b. All serviceability clearances stated in manufacturer's equipment/product data shall be strictly provided.

20. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES / SPEND DOWN PURPOSES

- a. If requested by the Owner's Representative, Contractor shall submit anticipated monthly spend downs which are estimates of all future monthly billings for the remainder of the project.
- b. Within thirty (30) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit the initial anticipated Monthly Project Spend Down estimates to the Owner's Representative and update and submit the updated estimates each month and include with the monthly pay application. The Spend Down estimates will include the Contractor's estimate for the probable value of each month's pay application amount. (minus 5% retainage values) The Spend Down estimate data will be reviewed monthly and jointly by the Contractor and Owner's Representative and adjusted based on the outcome of the discussion. The Spend Down estimates will incorporate not yet approved/proposed change order costs, time extensions and extended general conditions, as applicable.

21. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

- a. The Contractor shall be represented at the site a competent superintendent with no other assigned duties or responsibilities from the beginning of the work until its final acceptance, unless otherwise permitted by the Owner's Representative. The superintendent for the Contractor for the general building work shall exercise general supervision over all subcontractors of any tier engaged on the work with decision-making authority of the Contractor.
- b. The Contractor shall furnish on-site Internet access for use by his Project Manager and superintendent. The contractor shall utilize the Owner's secure information sharing system for submittals, construction payment process, change orders, RFI's/ASI's, O&M manuals and all other project manual requirements as directed by the Owner's Representative. Field staff are also required to utilize this software as directed by the Owner's Representative.
- c. The Contractor shall provide mobile technology/ telephone for use by the on-site superintendent to facilitate communication with the Owner's Representative.

22. 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.

23. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

- a. All crane and hoisting operations shall be performed in compliance with OSHA 29 CFR 1926. All Operators, riggers, and signal persons must have the proper qualifications and training necessary to perform the intended hoisting activities for this project.
- b. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an "Operator in Training" status shall not be used.
- c. Submittal requirements:
 - (1) Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.
 - (2) Submit Rigger and Signal Person qualifications to the Owners Representative.
 - (3) Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer's review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

24. BUILDING SYSTEM COMMISSIONING

- a. Contractor shall provide all personnel and equipment required to complete the commissioning activities referenced in the Commissioning Plan. The requirements of the commissioning plan shall be completed in their entirety before substantial completion and submitted as referenced in the Closeout Log.
- b. The contractor shall designate a competent person, separate from the superintendent or Project Manager, to act as the contractor's commissioning coordinator. The commissioning coordinator is responsible for planning, scheduling, coordinating, conducting and verifying all commissioning activities required by the commissioning plan and ensuring all building systems are complete, operable and

ready for use by the Owner. At a minimum, building ventilation systems, chilled/hot water generation systems, hydronic distribution systems, power distributions systems and fire detection and alarm systems, as applicable.

25. WARRANTY WALKTHROUGH

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

END OF SECTION

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT

Project Number: CP252301

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
033000	Cast-In-Place Concrete				
078413	Penetration Firestopping				
078443	Joint Firestopping				
079200	Joint Sealants				
079219	Acoustical Joint Sealants				
081113	Hollow Metal Doors and Frames				
081416	Flush Wood Doors				
083113	Access Doors and Frames				
087100	Door Hardware				
092216	Non-Structural Metal Framing				
092900	Gypsum Board				
099113	Exterior Painting				
099123	Interior Painting				
200800	Seismic Protection				
210020	Seismic Controls for FP Piping & Equipment				
210500	Fire Protection				
220010	Basic Plumbing Materials & Methods				
220020	Plumbing Vibration Isolation & Seismic Restraints				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT

Project Number: CP252301

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Discipline Responsible</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
220400	Plumbing Systems					
230020	Vibration and Seismic Controls for HVAC Piping and Equipment					
230100	Installation of Mechanical Piping					
230110	HVAC Water Systems Piping					
230150	Refrigerant Piping					
230100	Mechanical Insulation					
230810	Packaged Heating Cooling Units					
230930	Testing and Balancing					
230960	Temperature Controls					
260125	Medium Voltage Cables					
260130	Medium Voltage Switchgear					
260430	Service Switchboards					
260440	Generator Docking Station					
260470	Panelboards					
260475	Surge Protective Devices					
260526	Grounding Systems					
260620	Transfer Switches					
260500	Interior Lighting					

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT

Project Number: CP252301

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Discipline Responsible</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
267313	Liquid-Filled Transformers					
312000	Earthmoving					
321313	Concrete Paving					
321373	Concrete Paving Joint Sealants					
329219	Seeding					

SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT

Project Number: CP252301

Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
230810	Packaged Heating Cooling Units							
230960	Temperature Controls							
260310	Medium Voltage Switchgear							
260430	Service Switchboards							
260440	Generator Docking Station							
260470	Panelboards							
260620	Transfer Switches							

SECTION 1.E.5

CLOSEOUT LOG

Project: CAPITAL REGION MEDICAL CENTER - SWITCHGEAR REPLACEMENT

Project Number: CP252301

Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor / Subcontractor</i>	<i>Date Rec'd</i>	<i># of Copies</i>	<i>CPM Initials</i>	<i>Remarks</i>
GC / 3.11	As-built drawings					
GC/13.5.6	Final Affidavit of Supplier Diversity Participation for each Diverse Firm					
SC/20	Executed commissioning plan w/ required documentation					
	List special warranties and guarantees for each section					
	List any required maintenance stock, spare parts, etc.					
	List any special tools, keys, etc.					

SECTION 1.E.6

CP252301 CRMC Switchgear Replacement Commissioning Checklist

Commissioning Items by CSI Division	Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
1						
Building System Quality Assurance						
QA Agent - Conduct pre-installation meetings per specifications.					Meeting Minutes	☒
24119						
Selective Demolition						
Do not start demolition until utility disconnect and sealing has been verified in writing						☒
78413						
Penetration Firestopping						
Hold Preinstallation conference as specified					Meeting Minutes	☒
Perform Field Quality Control section of specifications					Test Report	☒
78443						
Joint Firestopping						
Hold Preinstallation meeting as specified					Meeting Minutes	☒
Perform Field Quality control section of specifications					Test Report	☒
79200						
Joint Sealants						
Hold Preinstallation meeting as specified					Meeting Minutes	☒

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
81113							
Hollow Metal Doors and Frames							
Hold Preinstallation meeting as specified						Meeting Minutes	☒
Inspect fire doors for compliance to specifications and code						Inspection Report	☒
81416							
Flush Wood Doors							
Hold Preinstallation meeting as specified						Meeting Minutes	☒
Inspect fire doors for compliance to specifications and code						Inspection Report	☒
87100							
Door Hardware							
Hold Preinstallation meeting as specified						Meeting Minutes	☒
Perform Field Quality Control section of specifications						test report	☒
Verify that all fire doors close and latch positively						test report	☐
87111							
Door Hardware							
Hold Owner training on Operation and Maintenance of door hardware per Demonstration section of spec						Sign-in Sheet	☒

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
92900						
Gypsum Board						
Construct mock-ups per specifications					Inspection Report	☒
Perform Field Quality control section of specifications					Test Report	☒
Stencil Fire and Smoke walls and perform inspection					Inspection Report	☒
99113						
Exterior Painting						
Build Mockup as specified					Inspection Report	☒
Furnish Extra Material as specified					Transmittal	☒
Perform Field Quality Control section of specifications					Test Report	☒
99123						
Interior Painting						
Furnish Extra Material as specified					Transmittal	☒
Perform Field Quality Control section of specifications					Test Report	☒
200800						
Seismic Protection						
Perform Field Quality Control section of specifications					Test Report	☒

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Provide Extra Materials as specified						Transmittal	☒
210500							
Fire Protection							
Flush, test and inspect stand piping per Testing section of specifications						test results report, NFPA 13 Certification	☒
Perform Flow Test section of specs						Test Report	☒
220000							
Plumbing General Conditions							
Hold MEP pre-installation meeting(s).						Meeting Minutes and Sign-up Sheet	☒
220400							
Plumbing Systems							
Perform Plumbing Systems Testing section of Specs						test report, certification	☒
230000							
Mechanical General Conditions							
Hold MEP pre-installation meeting(s).						Meeting Minutes	☒
230110							
HVAC Water Systems Piping							
Perform Propylene Glycol section of specs						Test Report	☒
230150							
Refrigerant Piping							
Perform Testing section of specs						Test Report	☒

5/28/2025

COM 4 of 8

Commissioning Items by CSI Division		Verified by: Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
230810							
Packaged Heating/Cooling Units							
Provide Factory Startup and Training per spec and manufacturers instructions						Startup Report/ Sign-In Sheet	☒
230910							
Start-Up, Cleaning and Testing							
Perform Pipe Systems Testing and Equipment by factory representative						Test Report	☒
Perform start up of Systems and Equipment by factory representative						Startup Report	☒
230930							
Testing and Balancing							
Ensure Final Report section of specification is performed						TAB Report	☒
Hold Pre balancing conference						Meeting Minutes	☒
Place outlet dampers in full open position							☐
Provide Owner with manufacturers outlet factors and recommended procedures for testing							☐
230960							
Temperature Controls							
Check all circuit breakers for proper rating							☐
Check amp draw on control panel transformer and I/O panel						Test Report	☒

Verified by:						
Commissioning Items by CSI Division	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Post laminated control diagram in mechanical room						☐
Verify power to all EMCS panels and equipment is complete						☐
Verify safety alarms hard wired to control panels						☐
Verify systems are completely operable and ready for testing and balancing						☐
260125						
Medium Voltage Cables						
Ensure Color of wiring matches plans and specs						☐
Perform resistance test as described in "Field Quality Control" section of spec					test reports	☒
260310						
Medium Voltage Switchgear						
Perform resistance test as described in "Field Quality Control" section of spec					test reports	☒
260430						
Service Switchboards						
Perform "Field Quality Control" section of spec					test reports	☒
260440						
Generator Docking Station						
Perform "Field Quality Control" section of spec					test reports	☒

Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Division	Name	Firm			
260500					
Common Work Results for Electrical					
Verify that every penetration through fire walls (re: life safety plans) has been properly firestopped				test reports	☐
260510					
Basic Electrical Materials and Methods					
Perform "Test" section of spec				Test Report	☒
260519					
Low Voltage Power Conductors and Cables					
Perform independent tests per "Field Quality Control" section of spec, including megohm/high pot tests				test report	☒
260526					
Grounding Systems					
Perform resistance test as described in spec.				test report	☒
260620					
Transfer Switches					
Perform tests as noted in "Field Quality Control" section of spec				test report	☒
Perform tests as noted in "On-Site Acceptance Test" section of spec				Test Report	☒
267313					
Liquid-Filled Transformers					
Perform all tests as noted in "Commissioning" section of spec				Commissioning Report	☒

Commissioning Items by CSI Division	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
Perform all tests as noted in "Field Quality Control" section of spec					test reports	☒
311000						
Site Clearing & Demolition						
Maintain dust control per contract documents						☐
Provide temporary fencing around drip lines of trees remaining						☒
312000						
Earth Moving						
Conduct site compaction tests per contract documents					test report	☐
312500						
Erosion Controls						
Perform inspection of installed controls every seven (7) calendar days and within 24 hours of rainfall.					written report after each inspection	☐
321313						
Concrete Paving						
Notify Owner's Representative 24 hours prior to placement of concrete.						☒

SECTION 1.F

INDEX OF DRAWINGS

All Drawings dated: 07/08/2025

C-001	Cover Sheet
AD-101	Architectural Demolition Plan – Hospital Basement
AD-102	Architectural Demolition RCP – Basement Floor
A-011	Architectural Life Safety Plan – Hospital Basement
A-012	Architectural UL Assemblies – Penetrations
A-031	Architectural Doors & Frames
A-040	Architectural Site Plan
A-051.1	Architectural Proposed Floor Plan – Hospital Basement
A-051.2	Architectural Above Ceiling Upgrades
A-051.3	Architectural Above Ceiling Upgrades
A-150.1	Architectural Proposed RCP – Hospital Basement
C101	Civil Existing Site Conditions
C102	Civil Site Demolition Plan
C103	Civil Site Utility Plan
C104	Civil Site Plan
C105	Civil Phasing Plan
C106	Civil Site Grading Plan
M-001	Mechanical Symbols, Abbreviations & General Notes
M-002	Mechanical Details
MD-101	Mechanical Basement Ductwork Plan – Demo
MD-201	Mechanical Basement Piping Plan – Demo
M-101	Mechanical Basement Ductwork Plan – Reno
M-201	Mechanical Basement Piping Plan – Reno
E-001	Electrical Symbols, Abbreviations & General Notes
E-002	Electrical One-Line Diagram – Demo
E-003	Electrical One-Line Diagram – Reno
E-004	Electrical Site Plan
E-005	Electrical Phasing Sequence
E-006	Electrical Details
E-007	Electrical Panel Schedules
E-008	Electrical Existing Panel Schedules
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E-013	Electrical Existing Panel Schedules
E-014	Electrical Existing Panel Schedules
E-015	Electrical Existing Panel Schedules
E-016	Electrical Existing Panel Schedules
E-017	Electrical Existing Panel Schedules
E-018	Electrical Existing Panel Schedules
E-019	Electrical Outage Schedule Coordination
ED-101	Electrical Basement Lighting Plan – Demo
ED-201	Electrical Basement Equipment Plan – Demo
E-101	Electrical Basement Lighting Plan – Reno
E-201	Electrical Basement Equipment Plan – Reno
P-001	Plumbing Symbols, Abbreviations & General Notes
PD-101	Plumbing Basement Plan – Demo
P-101	Plumbing Basement Plan – Reno
FP-001	Fire Protection Symbols, Notes, Legends & Schedules
FP-101	Fire Protection Plan

END OF SECTION

SECTION 1.G

PREVAILING WAGE RATES

1. The prevailing wage rates for Boone County as issued by the Missouri Division of Labor on the following pages.

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

Annual Wage Order No. 31

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

Todd Smith, Director
Division of Labor Standards

Filed With Secretary of State: March 8, 2024

Last Date Objections May Be Filed: April 8, 2024

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$61.30
Boilermaker	\$32.35*
Bricklayer-Stone Mason	\$55.22
Carpenter	\$51.42
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$45.65
Plasterer	
Communication Technician	\$57.87
Electrician (Inside Wireman)	\$58.36
Electrician Outside Lineman	\$32.35*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$32.35*
Glazier	\$65.64
Ironworker	\$69.98
Laborer	\$43.79
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$59.96
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$65.05
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$41.79
Plumber	\$72.46
Pipe Fitter	
Roofer	\$55.00
Sheet Metal Worker	\$58.29
Sprinkler Fitter	\$65.10
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

Heavy Construction Rates for
BOONE County

Section 010

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$63.45
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$80.19
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$50.35
General Laborer	
Skilled Laborer	
Operating Engineer	\$66.32
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

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 fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

END OF SECTION

SECTION 1.H
University of Missouri Health Care
Preliminary Project Site Compliance Survey

Project Number		Project Name	
Building		Location	
Contractor		Contact	
Date		Inspected By	

Barriers	YES	NO	N/A
1. Adequately sealed			
2. Door(s) equipped with approved self-closing device			
3. Door frame(s) sealed with approved gasket material			
4. Door (s) closed and positively latched			
5. Door(s) equipped with a sweep			
6. Exposed side of the barrier finished			
Comments:			
Air Filtration	YES	NO	N/A
1. Air filtration unit(s) operating @ Correct Speed			
2. Air filtration exhausted correctly			
3. Air filtration units equipped with a clean/proper filter			
4. Exhaust hose(s) installed correctly			
5. Negative air pressure verified — Manometer Installed Correctly			
6. HVAC Supply & Returns Adequately Seated			
Comments:			
Egress	YES	NO	N/A
1. Exits identified			
2. Exits clear and unobstructed			
Comments:			

END OF SECTION

SECTION 1.I

Health Care Construction Guideline (HCCG)

March 2025 Edition

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1. **Contractor Orientation**

It is **MU Health Care's** mission to conduct its operations in a manner to protect the health and safety of its employees, contractors and the environment. This letter is to notify you of our new site entry procedures. These procedures will be effective **March 1, 2025** and will be managed through Gatefeed (www.gatefeed.com). The requirements will be enforced starting **July 1, 2025**.

Site Entry Requirements

Annual Site-Specific Orientation (Required by OSHA)

Contractor individuals will be required to take our online site-specific orientation training **prior** to coming to the facility. The training will be good for 1 year from the date of completion. The training is currently only available in English.

Contractor Access to Gatefeed

All users will need to first create a user account. To do this, go to the link below, click the "Create an Account" button and follow the steps. <https://app.gatefeed.com/sessions/new>

Student permission level (All users needing to take training)

- This is the default permission level upon creating a user account
- It is used for accessing assigned training only (***most users will remain at this level***)
- Student level users can also self-register for training

Admin permission level (Supervisory users needing to manage employee training)

- This permission level is granted by request to Gatefeed
- It is used for managing training for multiple employees, accessing your own training and viewing compliance status of employees.
- Your company should have at least one Admin user but can have more than one
- To become an Admin send an email to support@gatefeed.com requesting your user account be "bumped up" to Admin permission level for your company. You will receive an email response when your permission level has changed. The email will have instructions for logging in and getting started. However, please feel free to call and get an over-the-phone tutorial on how to use the system.*

***Please be logged in prior to calling and mention that this is for the MU Health Care facility.**

Gatefeed Costs:

Since Gatefeed is a hosted service there is a fee for taking the training as follows:

Annual Training:

MU Health Care \$27/person

All fees are paid through the Gatefeed website by credit card. For your security, Gatefeed does not store your credit card information.

Gatefeed Support:

For any questions, please contact Gatefeed directly as follows:

Phone: 312-467-9884 option 1, Monday-Friday from 7:00am to 5:00pm CST

Email: support@gatefeed.com

2. **Emergency Contact Information & Phone Numbers**

Contractor shall provide list of emergency contacts and phone numbers for individuals responsible for responding to emergency situations which may occur 24/7.

Contact list to be included as a topic of discussion during the Pre-Construction Meeting and included in the meeting minutes.

Emergency contact list must be posted inside project entry door(s) for the duration of project.

3. **Contractor Identification Badge**

Contractor employees and subcontractor trade workers working on the project are required to wear a "Contractor Identification Badge" as outlined below.

Contractor ID Badge

1. Contractor shall produce ID badges for all its employees and subcontractor trade workers conducting work on an MUHC job site. It is the responsibility of the Contractor to provide the computer and color printer for reproduction of badges required. Consult the Owner's Representative for the electronic file. (Contractor to validate employee with proof of ID).
2. Contractor to edit the information, print in color, cut out the badges, fold in the center and insert in Contractor provided badge holders.
3. Contractor shall keep a log of badged employees by trade/subcontractor at the jobsite for reference by the Owners Representative.
4. Contractor employees are to wear the badge on the upper chest facing forward unless approved otherwise for safety reasons.
5. Project Managers, superintendents, and subcontractor foreman shall attend "Healthcare Construction Training" and affix issued "T" sticker in the circle area on badge as shown. This will show evidence that the employee has completed training. All badges to be collected by the Contractor and disposed of at the end of the project.
6. Contractor shall be responsible for daily self-check-in by scanning the QR code included on the individual's badge, or included on publication at the project site.
7. See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for "Example Contractor Badge".

4. **General Requirements for Health Care Projects**

The Contractor is responsible for understanding, planning and implementing the following requirements in the management of the project.

1. On-site worker clothing must be clean and free of holes or fraying.
2. On-site workers shall be fitted with a Contractor furnished shirt containing company name and logo.
3. On-site worker shoes/boots must be free of dirt/debris before entering and leaving the construction area.
4. If track-out occurs in an occupied area of the healthcare facility, you must stop and clean immediately by using a HEPA filtered vacuum and/or a clean dampened floor mop with a MUHC approved cleaning solution. All cleaning solutions must be approved by the Owner.
5. Assure that all construction material, equipment and tools are cleaned and covered with a clean cloth while transporting through the healthcare facility.

6. Ensure that wheels on delivery and trash carts are clean before leaving the construction area.
7. Patients, visitors, and staff ALWAYS have priority and the “Right of Way” in the elevators and corridors.

5. **Construction-Renovation-Maintenance Risk Assessment (CRMRA)**

The “Construction-Renovation-Maintenance Risk Assessment” (CRMRA) planning process establishes criteria and measures to protect patients, visitors and staff from construction activities that could lead to infections or impact life safety systems in the healthcare facility. [Facility – Construction, Renovation, Maintenance Risk Assessment – Policy](#)

The Owner’s Representative is responsible to develop and coordinate with the Contractor to prepare and facilitate these CRMRA planning activities with MUHC Engineering Services, Infection Control Department. Impacted departments and others as required during the duration of the project. The CRMRA requires the contractor to participate in the development of this document, display it at the jobsite, and comply with the standards defined therein.

See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for *“eMeditrack Assessment Checklist”*.

6. **Construction/Renovation/Maintenance Infection Control Risk Mitigation Criteria**

The “Construction–Renovation-Maintenance Infection Control Risk Mitigation Criteria” (CRMICRMC) is a process to evaluate projects for required interventions during construction. The goals are to minimize Hospital Acquired Infections (HAI’s) and control dispersal of air/water-borne infectious agents concealed within the building components.

All construction activities shall be defined and managed in such a way that exposure to dust, moisture, and accompanying hazards are mitigated.

1. Any work done outside the main project limits will require a NEW Infection Control Risk Assessment. See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for *“eMeditrack Assessment Checklist”*.
2. The Owner’s Representatives and Contractor will work together to coordinate the assessment and determine if MUHC permits (hot work, energized work, above ceiling, etc.) and associated requirements are needed.
3. The Owner’s Representative will ensure that all required infection control interventions and life safety measures required for the project are in place by the Contractor prior to starting work. (i.e., barrier walls, tacky mats, required exits, etc.)
4. The Contractor shall follow all requirements to support the “Construction – Renovation- Maintenance Infection Control Risk Mitigation Criteria”.
5. CRMIC Permit will provide requirements specific to the project.
6. See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for “Infection Control Contractor Check List”, utilized as a tool to aid understanding of good infection control processes through various phases of construction.
7. On-site workers that violate the requirements of the “Construction – Renovation- Maintenance Infection Control Risk Mitigation Criteria/Permit” will be removed from the project.

7. **Construction Barriers**

To protect patients, visitors, and staff from construction dust, fumes, and other exposures, an isolation barrier with or without negative air may be required to be established before construction activities may begin. Barriers are meant to strictly delineate the work area. When necessary, construction barriers will be called out by Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC).

1. A copy of the ICRMC describing barrier requirements shall be visibly posted on the barrier of the work area for the duration of the project.
2. Required barriers may be constructed with metal studs and drywall as detailed on the Infection Control Plan of the documents or an approved manufactured system as listed in section 9 and could also include one or more of the following:
 - (a) Existing wall assemblies;
 - (b) Rooms with doors that separate from adjacent spaces;
 - (c) Commercial rigid construction barrier assemblies;
 - (d) Constructed stud and wall board walls;
 - (e) Fire-resistant 6-mil polyethylene sheeting; or
 - (f) Portable containment units / HEPA carts.
3. Contractors are responsible for:
 - (a) Ensuring barriers are properly constructed and maintained for the duration of the project;
 - (b) Keeping the exterior of the barrier clean and free of damage;
 - (c) Securing entrances through the barrier to the work site (doors, zippers, etc.)
 - (d) Posting and maintaining signage on the barriers to
 - (i) Indicate "Construction Area, Authorized Personnel Only"; and
 - (ii) directional for staff and patient traffic, when necessary.
 - (e) Ensure that barrier entrances are kept closed and always secured.
4. Upon installation of barriers, before beginning work, the Contractor shall notify the Owner's Representative to coordinate an inspection. The Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC) requires approval from Infection Control before beginning work.
5. Upon the completion of work, the Contractor shall notify the Owner's Representative to coordinate the removal of barriers. The Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC) requires approval from Infection Control before removing barriers.

8. **Ventilation and Negative Air Requirements**

Establishing negative air means that the area under construction is negative relative to surrounding areas; this pressure difference prevents dust, fumes, and airborne contaminants and pathogens from escaping the construction area. When necessary, negative air requirements will be called out by Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC).

1. A copy of the ICRMC describing negative air requirements shall be visibly posted on the barrier of the work area for the duration of the project.
2. Negative air requirements may include one or more of the following:
 - (a) HEPA-filtered negative air ventilation units
 - (i) Exhausted directly outside;
 - (ii) Exhausted into an adjacent space or corridor;

- (iii) Recirculating (scrubbing) air within the work area; or
 - (iv) Integrated into portable containment units / HEPA carts.
- 3. Negative air pressure may not:
 - (a) Be achieved by using filtered HVAC air returns in any room, including isolation rooms; or
 - (b) Be exhausted into the HVAC system unless it is a portion of the exhaust that leads directly outdoors.
- 4. Contractors are responsible for:
 - (a) Sealing all HVAC supply and returns within the work area.
 - (i) Maintaining these seals may require Engineering Services to close dampers or disconnect ducts serving the work area.
 - (b) Regular maintenance of HEPA-filtered negative air ventilation units;
 - (c) Regularly cleaning prefilters and filters;
 - (d) Furnishing and installing a manometer on the outside of the barrier;
 - (e) Ensuring that negative air pressure in the work area is at least -0.01 inches of water column (WC);
 - (f) Daily documentation of the negative air pressure on the "Negative Air Pressure and Filter Change Log," posted next to the manometer.
 - (i) Logs will be collected by Infection Control at completion of the project.
 - (ii) See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for "Negative Air Pressure and Filter Change Log".
- 5. If the installation of a barrier is also required, the negative air units should be turned on before barrier construction begins.
- 6. Once negative air units are in place, the Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC) may require approval from Infection Control before beginning work.
- 7. Upon the completion of work, barriers should be removed before negative air units are removed; the Infection Control in the Infection Control Risk Mitigation Criteria (ICRMC) may require approval from Infection Control before the removal of negative air units.

9. **ICRM Equipment and Product Information**

Approved Equipment and Product Information

RIGID BARRIER SYSTEMS

- Lightweight modular wall system that meets or exceeds ICRA Class IV and ASTM E84 requirements with a minimum of 1 inch insulated wall panels.

Approved Manufacturers:

- STARC Systems

Temporary Wall Systems (TWS)

- Or approved equal.

NEGATIVE AIR HEPA FILTERED VENTILATION UNIT

- HEPA filter equipped negative air machines that provide rough in filters, primary filters and a HEPA final filter.
- Rating of 300 to 2000 cubic feet per minute, (CFM).
- HEPA filters must be a minimum 99.97% efficient @ 0.3 microns.

- Differential pressure alarm required if not installed in another fashion to monitor construction site negative air of – 0.01 water column. Or approved equal.
- MICRO Trap Corporation, Models MT 1000 or Model MT 2000. 1300 W. Steel Road, No. 2 Morrisville, PA 19067 (215) 295-8208 or (877) 646-8208.
- ABATEMENT Technologies, Inc. Model HEPA-AIRE PAS2400HC Portable Air Scrubber or Model PAS1200HC 605 Satellite Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091
- Or approved equal.

HEPA VACUUM

- Shop style vacuum with HEPA filter cartridge at 99.97% filtration @ 0.3 microns. Or approved equal.
- ABATEMENT Technologies Inc. Model V8000WD Canister Style Wet/Dry HEPA Vacuum. 605 Satellite Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091.
- ABATEMENT Technologies Inc. Model V1300H Hip Mounted HEPA Vacuum, designed for use on scaffolding and mobile conditions such as ceiling tile type cleaning. Lightweight at 6.4 lbs.
- 605 Satellite Blvd. Suite 300 Suwanee, GA 30024 (800) 634-9091.
- Or approved equal.

ADHESIVE WALK OFF MATS

- 24" x 36" Tacky Mat.
- Peel up dirty layer and dispose to reveal a new, fresh clean tacky mat.
- Tacky walk off mat No. 5838 24" x 36", 60 tacky mats to a unit. Four units per case.
- 3M Company, St. Paul, MN 55144 (888) 364-3577.
- Or approved equal.

NEGATIVE AIR PRESSURE INDICATOR

- Manometer.
- Model "Mark II Model No. 25 inclined-vertical Manometer. Dwyer Instruments Inc. PO Box 373, Michigan City, IN 46361 (219) 879-2000.
- MICRO Trap Corporation, Model Tri/Mon, digital recording manometer for tracking differential pressure.
- Contact info: 1300 W. Steel Road, No. 2 Morrisville, PA 19067 (215) 295-8208 or (877) 646-8208.
- Or approved equal.

PORTABLE WORK ENCLOSURE

- For temporary fire-resistant polyethylene dust barrier.
- System components supplier of zip poles, door opening access zippers, dust sealing system parts, etc.
- Contact info: Zip Wall, LLC. 37 Broadway, Arlington, MA 02474 (800) 718-2255.
- Or approved equal.

FIRE RESISTANT POLYETHYLENE

- For temporary dust barriers and use with Zip Wall Barrier System.
- Fire resistant polyethylene 6 mil.
- Underwriters Laboratories listed.
- Americover, Inc. 6 mil. Fire Retardant Polyethylene No. ASFR6. Use with Zip Pole System also sold by Americover.
- Contact Info: 2067 Wineridge Place. Suite F Escondido, CA 92029. 800-747-6095 Dept. 48.
- Or approved equal.

10. **Alternate Life Safety Measures Assessment (ALSM)**

Alternate Life Safety Measures (ALSM) are a series of administrative actions that must be taken to compensate temporarily for the hazards posed by existing NFPA Life Safety Code 101, 2012 edition deficiencies, other building code issues or construction activities. Examples of construction activities that may require ALSM's to be implemented are as follows:

1. Fire alarm system, detection, and/or sprinkler system are impaired or disabled.
2. Normal exits or exit routes and/or exit lighting have been compromised.
3. Re-routing of traffic due to construction activities.
4. Temporary narrowing of the corridor.
5. Deficiencies in fire and/or smoke separations and systems caused by construction activities. (Changes to wall, door, dampers, penetrations, etc.)
6. Emergency lighting not compliant.
7. Major and minor construction/renovation in an occupied health care occupancy.
8. Hot work.
9. Impairment or shutdown of a fire sprinkler system or fire alarm system for a period of 4 hours or longer in a 24-hour period.

Whenever an ***“Alternate Life Safety Measure”*** is identified for implementation during the construction project, there will typically be measures or actions required by both the MUHC Engineering Services department and the Contractor.

Prior to the beginning of work and throughout the project, the Contractor must be familiar with the ALSM to plan and identify construction related activities that will require an evaluation of ALSM's as noted in the ALSM. The ***“Alternate Life Safety Measures Evaluation”*** is a required team effort.

11. **Noise and Vibration Control Management**

Construction related noise/vibration control and mitigation measures are to be implemented when the Contractor is working in and around healthcare facilities. The Contractor shall work with the Owner's Representative to develop means and methods for controlling excessive noise and vibration during construction as identified in the contract document project plans and project manual.

12. **Above Ceiling Work**

Access to areas above the ceiling must be coordinated with the Owner's Representative. Depending upon the location and purpose of accessing areas above the ceiling, the Contractor may need to follow a standing protocol or obtain an *Above Ceiling Work Permit*.

1. Standing protocol
 - a. Above Ceiling Inspection Criteria / Minimal Dust Producing Protocol
 - i. To be used for visual inspection of mechanical, electrical, plumbing, structural components.
 - ii. May be used with fireproofing and VAV damper adjustment.
 - iii. Applies to all contractors, and vendors.
 - iv. See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for ***“Infection Prevention & Control Program – Above Ceiling Inspection Criteria (Minimal, Dust Producing) ICRA – Protocol”***.
2. Above Ceiling Work Permit
 - a. Must be requested for

- i. Any cable or wiring pulls through the healthcare facility.
 - ii. Other above ceiling work beyond the scope of visual inspection.
- 3. Contractors are responsible for:
 - a. Notifying the Owner's Representative three (3) business days prior to the need for above ceiling access.
 - b. Replacing ceiling tiles as soon as possible. Displaced ceiling tiles shall not be left unattended in areas not contained by a construction barrier.
 - c. Notifying the Owner's Representative to acquire replacement ceiling tiles if they are damaged during work.

13. **Utility Systems Shutdown & Service Permit**

"Utility Systems" shall be defined as any system that would hinder the delivery of patient care and hospital operations should the system be interrupted for any reason. Planning for this work usually requires a contingency plan by the healthcare facility management department to address any failure of the utility system. The contractor shall develop a graphical representation of the outage and affected areas for coordination and consensus with the owner's representative.

See Project Manual Section 1.J MU Health Care Additional Policies & Procedures for "Request for Outage" form.

Utility Outage

Utility or system connections, shut offs, or interruptions must be scheduled with the Owner's Representative prior to commencement of the work. This work shall be defined as either a "Planned" or "Unplanned Utility Outage" and notice shall be made to the Owner's Representative to coordinate the request and facilitation.

Utility Service

In addition to utility system connection, shut-off, or interruption, the Contractor must also schedule any work on existing utility systems that either do not require interruption or cannot be interrupted to accomplish the work. This type of work shall be defined as "Utility Service" and notice shall be made to the Owner's Representative. The Contractor shall give up to 14 calendar days' notice to the Owner's Representative to properly plan and coordinate required activities.

Electrical Safety

In accordance with National Fire Protection Association (NFPA) 70E, *Standard for Electrical Safety in the Workplace*, MUHC requires all contractors and service personnel performing services on MUHC owned or managed properties to always comply with OSHA and NFPA 70E (current edition).

The contractor shall complete the "Contractor/Vendor Acknowledgement of Electrical Safety Requirements & Training" form before mobilizing to the site, see Project Manual Section 1.J MU Health Care Additional Policies & Procedures.

14. **Hot Work & Permit**

Hot Work shall be defined as welding, brazing, cutting soldering, grinding, or other flame or sparking producing activities which are capable of initiating fires or explosions.

All Contractors performing construction activities in MUHC Facilities are required to follow the requirements and provisions of *NFPA 51B – 2024* and the Owner's Representative procedures related to Hot Work.

The following are the requirements for a Contractor to obtain a *"Hot Work Permit"*:

1. Contractors shall contact MUHC Engineering Services representative prior to requesting a *"Hot Work Permit"*.
2. Hot work permit requests for complex projects requiring extensive planning on behalf of the Owner and Owner's Representative may require several days' notice.
3. MUHC Engineering Services will issue a *"Hot Work Permit"* to be posted in the vicinity of the hot work being performed. Upon completion, the hot work permit shall be returned to MUHC Engineering Services.
4. All hot work sites are inspected by the Owner's Representative and/or MUHC Engineering Services representative using the requirements printed on the hot work permit.
5. Hot work permits are issued for each work shift unless other arrangements have been made with Owner's Representative.
6. If hot work cannot be completed within one work shift, the Contractor is responsible for obtaining approval for a revised permit extension from MUHC Engineering Services. The Contractor is responsible for meeting all safety requirements required by the permit for any extensions granted.
7. The Contractor shall be responsible for supplying an individual as a trained fire watch with no other assigned duties, for the duration of hot work, including during lunch and/or scheduled breaks. **The fire watch's only responsibility will be as a fire watch.**
8. All permits require a 1-hour fire watch following completion of hot work activity.
9. Contractor shall provide at a minimum a ten-pound (10) ABC fire extinguisher that has a current, valid inspection tag at each hot work location.
10. A copy of the *"Hot Work Permit"* shall be kept in the General Contractor's project file for future review as may be required.

15. Helicopter Approach/Take-off

Construction related activities on the hospital's grounds, property, or building roofs must follow the guidelines regarding construction activities during helicopter landings and take-offs at the helipad. The Contractor shall coordinate the following with the Owner's Representative:

- Roof access
- Roof protection
- Air care traffic safety precautions to be taken when conducting work on roofs.
- In addition, the placement of vertical installations such as tall lighting poles and the use of project cranes or hoisting on the hospital property might affect the "Approach and Take Off" of air care traffic. All construction related items such as dumpsters, fencing materials, signage, etc. must be secured. The manner by which these items are secured are to be approved by the Owner's Representative. It is essential that the Contractor coordinate these types of activities in advance with the Owner's Representative prior to the beginning of work.

16. Required Forms, Permits, Postings, and Documentation

Note: Refer to sections within the “Healthcare Construction Guideline” for detailed information on each form and permit approval procedure.

Category	Required Notice	Form	Permit Approval	Job Site Posting	Contractor Safety File
CRM Infection Control Construction Permit	Before Starting	√	√	√	√
Above Ceiling Permit	14 Days	√	√	√	√
Utility Systems Shutdown & Service Permit	14 Days	√	√	√	√
Fire Protection System Impairment Permit	14 Days	√	√		√
Hot Work Permit	2 Days	√	√	√	√
Lock Out/Tag Out Permit	14 Days	√	√	√	√
CRM Alternate Life Safety Measures Assessment		√			
Negative Air Pressure Log		√		√	√
CRM Risk Assessment		√			
Construction Safety Deficiency Notice		√			√
Violations and “Notice to Contractor”		√			√
Hazardous Material Abatement Signage				√	
Required Construction Jobsite Signage				√	
Alternate Life Safety Signage				√	
Contractor & Employee Training Acknowledgment		√			√
Contractor Safety Meeting Minutes					√

The Contractor will be required to furnish and install a “Project Safety Information” bulletin board on their project site for posting of required safety information. Small, short duration projects may have this requirement waived by the Owner’s Representative.

LEGEND CRM = Construction-Renovation-Maintenance

17. **Health Care Construction Cleaning Definitions**

Construction Clean (Contractor Responsibility)

Remove construction materials, tools, and equipment from the work area.

Remove all trash from the work area.

Thoroughly sweep all floor surfaces in the work area utilizing a dust compound (floor sweep) material.

Dry wipe all horizontal & vertical surfaces in the work area. Surfaces to include but not limited to walls, windowsills, doors & door frames, base trim, casework (inside & out), fixtures, and wall mounted equipment.

Sweep all floor surfaces utilizing a dust mop.

Wet mop all floor surfaces.

Thorough Clean (Contractor Responsibility)

To be implemented only after Construction Clean procedures have been completed.

Wet wipe all horizontal and vertical surfaces utilizing a MUHC – Infection Control Department approved germicidal disinfectant. Surfaces to include but not limited to walls, windowsills, doors & door frames, base trim, casework (inside & out), all fixtures, and wall-mounted equipment.

Wet mop all floor surfaces utilizing a MUHC Infection Control Department approved germicidal disinfectant.

Terminal Clean (Owner Responsibility)

To be implemented only after Through Clean procedures have been completed.

Cleaning procedures shall be conducted by MUHC trained Environmental Services, Sterile Processing or Surgical Services staff only.

Thoroughly clean and disinfect surfaces on the ceiling such as diffusers, light fixtures, and ceiling mounted devices & equipment.

Thoroughly clean and disinfect all equipment in the work area.

Thoroughly clean and disinfect all flooring including moving equipment & furnishings to allow access to all floor surfaces.

Move all portable equipment and furnishings away from the walls. Wet wipe and disinfect all wall surfaces and wall mounted equipment.

18. **Gatefeed Instructions**

Starting March 1, 2025, MU Health Care facilities will be using Gatefeed, Inc. to manage contractor site orientation training online. Self-registration is required for this training, and/or a company Administrator can be established in Gatefeed to pre-pay and pre-assign this training to employees. Instructions are listed below for becoming an Administrative user.

Self-Registration Instructions (Individual users registering themselves)

Go to <https://app.gatefeed.com/sessions/new>

Login with your current Gatefeed user account or click the *Create an Account* button to create your Gatefeed user account.

From the Home page click the *Purchase* button to the left.

Start typing Your Employer Name (Not the facility name!) and select from the list that forms then click Continue. Note: Contact Gatefeed if your company is not listed.

Select the company name of the facility you will be going to: *University of Missouri Health Care*.

Select the course by checking the box and then proceed to payment.

-OR-

Contractor Company Administrator Instructions (Contractor Administrators registering their employees). To become an Admin user for your company please first create your user account by going to the link displayed above and clicking the "Create an Account" button. Once complete, send an email to support@gatefeed.com requesting to be bumped up to Admin permission level for your company (please state your full company name).

After logging in, go to your "Employees" tab

Single click on the employee's name to open their window

Go to the "Order" tab within the employee window

Select the company name of the facility you will be going to: *University of Missouri Health Care*

Select the course by checking the box and then continue to payment.

Gatefeed Customer Service: 312-467-9884 or support@gatefeed.com

END OF SECTION

SECTION 1.J

Title: Infection Prevention & Control Program- Above Ceiling Inspection Criteria (Minimal, Dust Producing) ICRA- Protocol

MU Health Care	Document Owner: Cameron Schroeder	Last Approved Date: 07/25/2024
	Content Expert: Cathy Schlotzhauer	Ref# 22516

Printed copies are for reference only. Please refer to the electronic copy for the latest version.

I. Purpose Statement

- a. To provide a process for ensuring a safe environment for patients, visitors and staff when undergoing construction.
- b. The standardization of this protocol is to be used as the infection control risk assessment (ICRA) with interventions for planned or unplanned above ceiling access for inspection with minimal to no dust production.

II. Definitions

- a. Above ceiling access protocol: should be utilized for inspections of VAV dampers, pipes, ceiling, cables, or fireproofing, etc.
- b. Work area: space directly below an open ceiling tile; encompasses a 6-foot radius.
- c. Portable Containment Unit (PCU): mobile containment equipment with the ability to extend up to ceiling to seal off work areas to prevent the spread of dust.
- d. Polyethylene sheeting: light plastic covering utilized to prevent contamination of stationary equipment during work periods. Removal involves folding the polyethylene into itself to reduce the risk of debris falling onto surfaces in the room/space. Contaminated polyethylene shall not be reused.

III. For use by

- a. This protocol applies to all construction staff, maintenance staff and outside vendors performing duties at University of Missouri Health Care facilities.

IV. Content

- a. Non-Patient Care Areas (e.g., office, clinic off hours, electrical, mechanical rooms, corridor of ground floor at UH, corridors in non-patient care areas, cafeteria, chapel, lobbies).
 - i. May remove one tile at a time from the suspended ceiling system.
 - ii. Remove portable equipment/items from under the work area. Items that cannot be removed shall be covered with polyethylene sheeting.

- iii. "Clean as you go" utilizing a hepa filtered vacuum to clean up any debris.
- b. Patient Care Areas (ex. general care units, diagnostic testing areas, emergency department, pharmacy)
 - i. There shall be no patient in the room/space. Off hours work may be warranted due to delays in access to the specific space.
 - ii. May remove one tile at a time from the suspended ceiling system.
 - iii. Remove portable equipment/items from the work area. Items that cannot be removed shall be covered with polyethylene sheeting.
 - iv. "Clean as you go" utilizing a hepa filtered vacuum to remove tile debris.
- c. Sub Sterile/Sterile Environment (e.g., Operating room, sterile processing, Intensive Care, procedure room, laboratory, and compounding pharmacy).
 - i. All work activities shall be conducted during off hours. The off hours are determined by individual departments and are subject to change, ii. All workers shall wear appropriate surgical attire. The attire includes disposable head cover, surgical mask for persons with facial hair, approved freshly laundered scrub suit or disposable surgical coverall, and shoe covers.
 - iii. May remove one tile at a time from the suspended ceiling system utilizing a portable containment unit (PCU) whenever possible. If the ceiling is too high or area too small for PCU, remove portable equipment/supplies from the work area. Items that cannot be removed shall be covered with polyethylene sheeting.
 - iv. Corridor doors adjacent to the work area shall be closed during the work period.
 - v. "Clean as you go" utilizing a hepa filtered vacuum to remove tile debris immediately.
 - vi. If more than one tile is lifted in these areas, contact EVS for thorough cleaning.

V. Reference Documents or Attachments

- a. Guidelines for Environmental Infection Control in Healthcare Facilities. CDC. (2019). <https://www.cdc.gov/infectioncontrol/pdfguidelines/environmentalguidelines-P.pdf>.
- b. Infection Control Risk Assessment Matrix of Precautions for Construction & Renovation. ASHE. (2009). https://www.ashe.org/sites/default/files/ashe/assessment_icra.pdf
- c. Construction and Renovation. APIC. Chapter 118. (2019). <https://text.apic.org/toc/infection-prevention-for-support-services-and-the-care-environment/construction-and-renovation>

END OF SECTION

Title: Life Safety - Hot Work Permit - Policy

MU Health Care	Document Owner: Jennifer Brooks-Ditzfeld	Last Approved Date: 11/22/2022
	Content Expert: Stephen Potter	Ref#21438

Printed copies are for reference only. Please refer to the electronic copy for the latest version.

I. Policy Statement

- a. The University of Missouri Health Care (MUHC) shall establish policies, processes, and procedures to identify, assess, and mitigate risks and hazards arising from hot work operations.
- b. This policy applies to the University Hospital (UH), Missouri Orthopedic Institute (MO)), Missouri Psychiatric Center (MUPC), Women's Hospital (WH), and operations at MUHC clinics and support facilities.

II. Definitions

- a. Shall indicates a mandatory requirement.
- b. Permit Authorizing Individual (PA) the individual(s) designated by management to authorize hot work.
- c. Designated area —v a permanent location designed or approved for hot work operations.
- d. Permit Required Area — an area that is made fire safe by removing or protecting combustibles from ignition sources.
- e. Hot Work — is work involving any open flame, spark or heat producing activity associated with cutting, welding, grinding soldering, brazing or torch applied roofing that are capable of initiating fires and explosions during construction, renovation, or maintenance work activities.
- f. Fire Watch a temporary process of physically patrolling in an area that has an impaired fire alarm system, fire sprinkler system or an area where hot work is being performed to observe and correct life safety deficiencies and initiate fire response should a fire occur during the impairment or high-risk work activity.
- g. Welding and Allied Processes — processes such as arc weld, oxy-fuel gas welding, open flame smoldering, brazing, thermal spraying, oxygen cutting, and arc cutting.
- h. Welding Blanket — a heat resistant fabric designed to be placed in the vicinity of a hot work operation. Intended for use in horizontal applications with light to moderate exposure such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal weld. Designed to protect machinery and prevent

ignition of combustibles such as wood that are located adjacent to the underside of the blanket.

i. Welding Curtain — a heat resistant fabric designed to be placed in the vicinity of a hot work operation. Intended for use in vertical applications with light to moderate exposures such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal welding. Designed to prevent sparks from escaping a confined space.

j. Welding Pads — a heat resistant fabric designed to be placed directly under the hot work operation such as welding or cutting. Intended for use in horizontal applications with severe exposures such as that resulting from molten substances or heavy horizontal welding. Designed to prevent the ignition of combustibles that are located adjacent to the underside of the pad.

III. Process/Content

a. Roles and Responsibilities:

- i. The Directors of Engineering Services (ES) and Planning- Design & Construction (PD&C) or his/her designee shall designate permit authorizing individuals (PAI's). PAI's may include Managers, and Supervisors, Coordinators and Project Managers.
- ii. The Director Engineering Services (or designee) shall maintain copies of completed work permits for the current year, plus one additional year.
- iii. PA's administer the hot work program. Prior to issuing a hot work permit, they shall inspect the hot work site and ensure the protection of combustibles from ignition by:
 1. Considering alternative methods to hot work.
 2. Moving the work to a location that is free from combustibles.
 3. If the work cannot be moved, moving the combustibles to a safe distance, or having the combustibles properly shielded against ignition. (i.e., blankets, curtains, or pads).
 4. Scheduling hot work so that operations that could expose combustibles to ignition are not begun during hot work operations.
 5. if these criteria cannot be met, hot work shall not be performed.
 6. The PAI and/or supervisor overseeing the hot work shall ensure task-related worker protection such as proper protective equipment (PPE) and proper ventilation are assessed and provided.
 7. When all these criteria are met the PAI can sign in his/her signature block on the Hot Work Permit.

iv. Personnel Performing Hot Work (Contractors/Sub-Contractors/MU Employees shall:

1. Conduct an inspection of the work site to verify compliance with safety precautions
2. Obtain Hot Work Permit prior to commencing hot work activities.
3. Notify the Alarm shop (884-3834) to minimize the risk of nuisance fire alarms.
4. Comply with applicable fire safety codes when performing hot work activities.
5. Have a fully charged and operable fire extinguisher (2A — 10B, C) on the work site.
6. Assign a Fire Watch strictly for fire watch duty and have them sign the appropriate signature block on the Hot Work Permit.
7. Properly process the Hot Work Permit prior to commencement of work. They shall:
 - a. Sign the appropriate signature block on the Hot Work Permit;
 - b. Place the top sheet in the "In Progress" box located in (UH) GE-13 or (WH) Engineering Office, and;
 - c. Post the bottom copy in or outside the Hot Work area.
8. When the Hot Work is completed. Notify the Alarm shop to return the fire alarm system to service.

v. Fire Watch:

1. The fire watch shall be trained to recognize the inherent hazards of the work site and hot work operations; ensure that safe conditions are maintained during hot work during hot work operations; and has the authority to stop any unsafe condition during the hot work operations.
2. A fire extinguisher shall be readily available, and the fire watch shall be trained in its use. The fire extinguisher shall be located within 35 feet of the hot work area with a minimum classification of 2A-10 B, C.
- 3, The fire watch shall follow the facilities and procedures for sounding an alarm in the event of smoke and/or fire.

R	Rescue	Remove persons in immediate danger & proximity of the fire.

A	Alarm	1. Activate a fire alarm pull station 2. Call emergency number & provide details 1-1111. 3. Off-Site personnel will dial 911.
C	Confine	Prevent the spread of fire & smoke by closing all doors.
E	Extinguish/ Evacuate	1. Extinguish the fire if this can be done safely with the fire extinguisher: and 2. Evacuate the area.
P	pull	Pull the pin attached to the extinguisher.
A	Aim	Aim the Nozzle at the base of the fire.
S	Squeeze	Squeeze the handle to discharge the extinguisher.
S	Swee	Swee the nozzle for side to side at the base of the fire.

4. An additional fire watch shall be required if combustible materials that could be ignited by hot work operation cannot be directly observed by the initial fire watch.
5. Personnel assigned to fire watch cannot be assigned to any other duties.
6. A fire watch shall be maintained for 60 minutes after the completion of the hot work operations to detect and extinguish smoldering fires.
7. The fire watch can be extended if the PAI determines the fire hazards warrant the extended time, up to 3 hours.
8. Upon satisfactory completion of the required timeframe of the fire watch. The fire watch shall sign Fire Watch sign-off portion of the posted hot work permit. On both signature blocks.
9. Place the completed Hot Work Permit in the finished box in (UH) GE-13 or (WH) Engineering Office.

b. Procedures:

i. Work Site Inspection/Safety Precautions:

1. Prior to the issuance of a Hot Work Permit — the PAI and person performing the hot work shall inspect the work site to verify safety precautions can be met. The work site inspection shall include a compliance verification of, but not limited to, the following:
 - a. Appropriate fire extinguisher(s) are available and operable at the site of the work being performed.
 - b. Flammable and Combustible materials and debris have been moved at least 35 feet from the hot work area. If these materials cannot be removed. Flammable and Combustible

materials shall be covered by the appropriate fire resistance material (e.g., fire blanket, curtain, and pad).

- c. Flammable and Combustible liquids, compressed gas cylinders, or stored fuel have been moved at least 35 feet from the hot work area or covered and protected from the hot work with fire resistant material.
 - d. Smoke and fire detectors in the immediate area of the hot work have been temporarily disabled until hot work is completed. This can only be performed by contacting the Alarm Shop at 884-3834.
 - e. Adequate ventilation is provided, especially when cutting or welding materials with painted or coated surfaces. Preferably, ventilated to the outside or run through a HEPA filter.
 - f. Cracks or holes in floors, walls, and ceilings (including ductwork) have been properly covered or plugged.
 - g. Where combustible materials, such as paper clippings, wood shavings, or textile fibers, are on the floor, the floor shall be swept clean for a radius of 35 feet.
 - h. Hot work equipment is operable and in good condition.
 - i. If working on any drum, barrel, or tank, it shall be cleaned and purged of flammables and toxic vapors, all tank feeds closed, and the tank vented.
 - j. Persons performing the work and conducting the fire watch know how to use a fire extinguisher and have been briefed on the MUHC Emergency Quick Guide procedures.
 - k. Equipment and supplies are stored in a manner that prevents hazardous conditions.
- ii. Hot Work Permit:
- 1. PAI will issue a hot work permit prior to any hot work operations in a permit-required area.
 - 2. A hot work permit shall not be valid for a period exceeding 24 hours.
 - 3. Combustible floors shall be kept wet, covered with damp sand, or protected by a listed welding blanket, welding pad, or equivalent.
 - 4. Where floors have been wet down, personnel operating arc welding equipment or cutting equipment shall be protected from possible electric shock.
 - 5. All combustibles shall be relocated at 35 feet in all directions from the work site.
 - 6. If relocation is impractical, combustibles shall be protected by a listed or approved welding curtain, blanket, pad, or equivalent. If hot work is done on one side of a wall, partition, ceiling, or roof, the following criteria shall be met:

- a. Additional fire watch shall be located on the other side of the wall or ceiling.
- b. Equipped with a fire extinguisher
- 7. Precautions shall be taken to prevent ignition of combustibles on the other side by relocating the combustibles.
- iii. Designated locations:
 - 1. A designated location is designed and approved for hot work operations that are maintained fire safe. MUHC designated are as follows:
 - a. MUHC - GE13A, GE19, C0013
 - b. Nelwood Facility
 - c. WH - 1056A
 - 2. Designated locations may have limitations on what hot work is allowed.
 - a. These limitations will be listed on the annually reviewed permit issued by the Life Safety Compliance Coordinator.
- i. Obtaining a Hot Work Permit
 - 1. Hot work permits are located at the University Hospital, Ground Floor, room GE13, permits are located in a slot on the wall, and the WH Engineering Office.
 - 2. Permits shall be completed in their entirety. Upon completion the permit is to be signed by the PAI.
 - a. Sign the appropriated signature block on the Hot Work Permit;
 - b. Place the top sheet in the "In Progress" box located in (UH) GE-13 or (WH) Engineering Office, and;
 - c. Post the copy in or outside the Hot Work area.

IV. Attachments

a. Life Safety — Fire Watch -Policy

V. References, Regulatory References, Related Documents, or Links

- a. Det Norske Veritas (DNV), National integrated Accreditation for Healthcare Organizations (NIAHO), Physical Environment, PE.2, SR.4
- b. National Fire Protection Association (NFPA), 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, 2009.
- c. Occupational Safety and Health Administration (OSHA), 1910.252, Welding, Cutting, and Brazing.

END OF SECTION

SECTION 1.L

	
Enter Name	
Enter Company Name	
Project#:	Enter Project #
Project Name:	Enter Project Name
• xpires:	Enter Expiration

	
Enter Name	
Enter Company Name	
Project#:	Enter Project #
Project Name:	Enter Project Name
• xpires:	Enter Expiration

	
Enter name	
Enter Company Name	
Project#:	Enter Project #
Project Name:	Enter Project Name
• xpires:	Enter Expiration

Protocol for Hospital Contractor Badges:

Contractor to issue badges to employees as necessary. (Need to show proof of ID)

Contractor to edit the information, print in color, cut out the badges, fold in the center and insert in badge holders.

Contractor shall keep a log of badged employees on site for reference by MU as necessary.

All permits to be collected and returned to MU at the end of the project.

Any orientation required will be discussed at the preconstruction meeting with the Owner's Representative.

END OF SECTION

SECTION 1.M



Negative Air Pressure and Filter Change Log

Project #	Location

[illegible]

This log shall be posted near the manometer. The air pressure difference shall be documented at the start of each work shift. The work area shall be maintained at a negative air pressure of at least .01 inches of water column at all times. If at any time the pressure is greater than -.01 inches of water column, all work shall cease inside the designated work area. Completed forms shall be submitted to the Construction Project Manager.

END OF SECTION

SECTION 1.N

Title: Life Safety - Fire Watch/Sprinkler System Impairment - Policy

MU Health Care	Document Owner: Jennifer Brooks-Ditzfeld	Last Approved Date: 11/22/2022
	Content Expert: Stephen Potter	Ref#4705

Printed copies are for reference only. Please refer to the electronic copy for the latest version.

I. Policy Statement

- a. The University of Missouri Health Care (MUHC) shall implement policies, processes, and procedures to establish a viable fire watch program part of our comprehensive fire prevention program.
- b. A 'fire Watch' will be implemented for the following conditions:
 - i. Fire alarm system is out of service for more than 4 hours in a 24-hour period.
 - ii. Where a fire protection system is out of service for more than 10 hours in a 24-hour period, or; iii. As required to address risk associated with hot work. Fire watch criteria related to hot work will be governed by Life Safety -Hot Work Policy.
- c. This policy applies to the University Hospital (UH), Missouri Orthopedic Institute (MOI), Missouri Psychiatric Center (MUPC), Women's Hospital (WH).

II. Definitions

- a. Fire Watch a temporary measure intended to ensure continuous and systematic surveillance of a building or portions thereof by one or more qualified individuals for the purpose of identifying and controlling fire hazards, detecting early signs of unwanted fire, raising an alarm of fire, and notifying the fire department.
- b. Alternative Life Safety Measures (ALSM: ALSMs are actions — to include administrative actions — taken to temporarily compensate for hazards or life safety deficiencies posed by construction, renovation, and maintenance risk activities.
- c. Hot Work: work involving any open flame, spark or heat producing activity associated with cutting, welding, grinding soldering, brazing or torch applied

roofing that are capable of initiating fires and explosions during construction, renovation, and maintenance risk activities.

- d. Fire Protection Systems: sprinkler systems, standpipe systems, fire hose systems, underground fire mains, fire pumps, water storage tanks, water spray fixed systems, foam-water systems, and emergency lights.
- e. Impairment: a fire protection system shutdown, in whole or part.
- f. Emergency Impairments: when a fire protection system is out of service due to an unexpected occurrence (i.e., leaks, interruption to water supply), such as a ruptured pipe or an unexpected equipment failure.
- g. Pre-Planned Impairment: when a fire protection system is out of service due to work that is planned, such as revisions to the water supply, sprinkler piping, and fire alarm system.

III. Process/Content

a. Roles and Responsibilities:

- i. The Director of Engineering Services shall establish internal processes and procedures, to comply with Fire Watch policy requirements derived from ES maintenance functions and activities whether the maintenance activities are conducted by ES personnel or a contracted function.
- ii. The Director of Planning, Design, and Construction (PD&C) shall establish internal processes and procedures to comply with Fire Watch policy requirements derived from PD&C construction and renovation activities that are conducted by PD&C personnel or a contractor function.
- iii. Safety and Emergency Management shall establish internal processes and procedures to:
 - 1. Integrate Fire Watch policy requirements into Alternative Life Safety Measures, and;
 - 2. Provide oversight of program activity and performance.
- iv. Project managers, construction managers, maintenance managers, and maintenance supervisors initiating or overseeing maintenance, construction or renovation tasks resulting in outages or impairments shall initiate an assessment request detailing the work to be accomplished, location, impacted/impaired utilities/utility outages and expected duration.
- v. Personnel assigned fire watch duties shall:
 - 1. Be provided with a least one approved means for notification of the fire department (e.g., 2-way radio or cell phone.)

2. Perform a continuous tour of the building or the portion of the building affected by the impairment at not more than 1-hour intervals. During these tours the fire watch will check:

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- a. Portable fire extinguisher is in place.
- b. Corridors and exits are clear and free of obstruction.
- c. Fire and Smoke barrier doors are not wedge opened.
- d. Area is clear of unnecessary trash and combustibles.

3. Complete fire watch tour documentation, Fire Watch Log at Appendix A. A sample of a completed fire watch log can be found at Appendix B.

b. Procedures:

- i. Pre-Planned Impairment: For pre-planned construction, renovation or maintenance activities that will result in fire alarm or fire protection system impairment expected to meet or exceed the criteria in paragraph I(b)(i)-I(b)(ii) (fire alarm impairment of 4 hours in a 24-hour period or fire protection system is out of service for more than 10 hours in a 24-hour period) a fire watch shall be established at the beginning of all such activities.

1. For maintenance activities, the Director of Engineering Services (or their designee) is responsible for establishing the fire watch.
2. For construction, or renovation the Director of PD&C (or their designee) is responsible for establishing the fire watch.
3. In all such cases, the following procedures apply to pre-planned activities requiring a fire watch
 - a. Any MUHC employee, contractor, subcontractor, or outside worker who impairs a fire protection system, in whole or part, will verify an assessment request has been processed with sufficient information to alert the Fire Protection Systems Supervisor (FPSS) or the impairment.
 - b. The FPSS or designee will authorize the preplanned fire alarm or fire sprinkler systems impairment and verify that the following procedures have been implemented:
 - i. The extent and expected duration of the impairment have been determined.
 - ii. The area or building involved have been inspected and the increased risks determined.

- iii. Where a required fire protection system is out of service for more than 10 hours in a 24-hour period and fire alarm system that is out of service for more than 4 hours in a 24-hour period, one or

-

more of the following compensatory measures shall be taken:

- 1. Evacuation of the building or portion of the building affected by the system out of service, and/or
 - 2. An approved fire watch, if passes the 4-hour or 10-hour deadline on fire sprinkler or fire alarm systems, and/or;
 - 3. Establishment of a temporary water supply, and/or;
 - 4. Establishment and implementation of an approved program to eliminate potential ignition sources and limit the amount for fuel available to the fire.
- iv. The FPSS shall notify the following agencies via email prior to or at the time of implementation of a fire watch and when the fire watch is ended:
 - 1. The Columbia Fire Department,
 - 2. Life Safety Compliance Coordinator,
 - 3. MUHC Security Dispatch,
 - 4. Engineering Services Mechanical Plant Specialist(on duty)
 - 5. Engineering Service leadership,
 - 6. House Manager of the areas affected by the system, and
 - 7. Insurance Company
 - 8. In the event, the FPSS cannot be reached; disseminate in accordance with Life Safety — Fire Sprinkler Outage Point of Contact (i.e., Assistant Fire Marshal CFD, FM Global, etc.) all sprinkler outages.

ii. Emergency Impairment: In the event of an emergency impairment any of the following personnel may initiate a fire watch: the Director of Engineering Services, Manager of Building Operations, Fire Protection System Supervisor, or any Safety & Emergency Management staff.

1. When an emergency impairment occurs, emergency action will be taken to minimize potential injury and damage.

-

2. The FPSS will implement all assigned tasks of the FPSS roles under Pre-Planned Impairments with the following exception:

- a. Any damage to the fire protection systems caused by the contractor will be repaired by a licensed fire protection company at the contractor's expense. Any required fire watch activities due to damage of the fire protection equipment will be provided by the contractor. Contractor must supply their own fire watch personnel to ensure compliance with this policy and other MUHC policies, i.e. Hot Work Policy.

iii. Restoring the System to Service

1. When all impaired equipment is restored to normal working order, the FPSS will verify that the following procedures have been implemented.

- a. Any necessary inspections and tests have been conducted to verify that affected systems are operational.
- b. All Directors, Supervisor, Department Heads, Fire Department, Monitor Company, and Insurance company have been notified via email.
- c. Documentation

i. Alternative Life Safety Measures (ALSM) documentation shall be completed in accordance with MU Health Care — Life Safety — Alternate Life Safety Measures- Policy.

ii. A "Fire Watch Log" will be completed by one of the personnel assigned to conduct the Fire Watch. Completed logs will be submitted to the Life Safety Compliance Coordinator and Fire Protection System Supervisor, as a component of the ALSM documentation.

iii. The Life Safety Compliance Coordinator and Fire Protection System Supervisor will store the fire watch logs in a central location so they can be readily provided if requested during an inspection.

iv. Logs be maintained for the current year plus previous year.

d. Personnel and Qualifications

i. The Fire Watch duties may be performed by Engineering Services or Planning, Design, and Construction staff, or by qualified contractor personnel.

ii. Qualified Individuals — Personnel are considered qualified if they are trained to recognize and response to a fire situation in a competent and professional manner. Training should include but is not limited to the following:

1. Proper use of fire extinguishers applicable to the hazard present.
2. Identify and controlling fire hazards.
3. Proper use of communication methods(s) for alerting building occupants and the fire department of a fire.
4. Location of the "fire watch" area, including the specific routes to be taken and specific hazards identified within the watch area.

iii. Supervisors are responsible for ensuring personnel are trained prior to being assigned as a fire watch.

iv. Just in time training that meets the requirements above is acceptable.

IV. Attachments

- a. Life Safety -Hot Work Policy.
- b. MU Health Care - Life Safety - Alternate Life Safety Measures Policy
- c. Life Safety – Fire Sprinkler Outage Point of Contact

V. References, Regulatory References, Related Documents, or Links

- a. Det Norske Veritas (DNV), National integrated Accreditation for Healthcare Organizations (NIAHO): PE.2 SR.8
- b. The National Fire Protection Association (NFPA) Life Safety Code 101 -2012, section 3.3.104 & 9.6.1.6:
- c. The National Fire Protection Association (NFPA) 25 Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection System, 2011, Chapter 15.

MU Health Care

Firewatch Log Sheet ADDRESS

Time	Designated Fire Watch	Notes

COMMENTS:

Please return this form to the Fire Protection Systems Supervisor & Life Safety Coordinator (Use reverse side of this paper, if needed)

Appendix B: Sample Fire Watch Log

Sample Fire Watch Log

ADDRESS UH 4 East

Time	Designated Fire Watch	Notes
0045	John or Jane Doe	Started Fire Watch
0115	John or Jane Doe	Second Tour
0145	John or Jane Doe	Notified Maintenance Crews are working on the sprinkler system.
0215	John or Jane Doe	Sprinkler sys. is back online. End Fire Watch

COMMENTS:

John or Jane Doe contacted MPS to place the Fire Alarm system back into service.

END OF SECTION

SECTION 1.0

Engineering Services



Request For Outage

Today's Date:

Attention:

This Request for Outage (RFO) form should be utilized to request a planned outage. A planned outage is a system or service outage or disruption that has been planned and scheduled. Non-emergency outage requests should be made no later than 10 working days prior to the requested date to ensure all those affected by the outage have adequate time to notify occupants and put in place any required contingency plans.

Contractor (Name, Phone & Email)	
Project Name <i>(if applicable)</i>	
Project # / Work Order # <i>(if applicable)</i>	
Reason for Outage	

For any questions, please contact the University Health Care Engineering Services Office 573-882-3639

Please scan and email to UMHC Outage-Request email address: umhcoutage-request@health.missouri.edu

Outage Details

Type of Outage: <i>(system or systems affected)</i>				
Location of Outage: <i>(Building Name/Floor/Room)</i>				
Proposed Start Date & Time:	Date:		Time:	
Estimated End Date & Time:	Date:		Time:	

Outage Contacts *(complete all applicable)*

Outage Project Manager:		
Outage Proj.Mgr. Phone # & Email:		
Supervisor Contact Name:		
Supervisor Phone # & Email:		
1 st Alternate Contact Name:		
1 st Alternate Phone # & Email:		

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END OF SECTION

SOLERAN SYSTEM: WORK REQUEST ENTRY CHECKLIST

Project Work Name			
Project / Work Order #		Date of Request	
Trade/Vendor/Project Manager		Start Date	
Name:		End Date	
Email:			
Phone:			
Location of Work			
Building			
Floor			
Specific Site for Work - Be as specific as possible include Room #'s			
Activity Scope and Comments			
File Upload – Insert up to four (4) documents			
--- IMPORT SPECIFIC PLANS ---			

Will any fire protection systems be impaired or have to be taken out of service?	Y	N	N/A
Comments:			
Will building access or egress be impaired?	Y	N	N/A
Comments:			
Will there be impediments to or corridor restrictions?	Y	N	N/A
Comments:			
Will there be flammable hazards or increased combustible fuel loads in the activity area?	Y	N	N/A
Comments:			
Will the activity require “Hot Work”?	Y	N	N/A
Comments:			
Will existing horizontal or vertical fire or smoke barriers be breached?	Y	N	N/A
Comments:			
Will the activity require the use and/or storage of hazardous chemicals?	Y	N	N/A
Comments:			

Will there be HVAC modifications? (If so, required testing & balancing or recertification may be mandated)	Y	N	N/A
Comments:			
Will the activity require asbestos, lead, or mold abatement? (please specify)	Y	N	N/A
Comments:			
Will the activity require confined-space entry?	Y	N	N/A
Comments:			
Will the activity require utility outages? (electrical, domestic water, HVAC, med gas, sanitary sewer, steam, etc.)	Y	N	N/A
Comments:			
Will the activity generate noise or vibration levels that may affect patient safety?	Y	N	N/A
Comments:			
Will the activity require off-hours work?	Y	N	N/A
Comments:			
Will modifications or additions to security technology be required? (cameras, panic device, card access system, etc.)	Y	N	N/A
Comments:			
Will the work require hoisting of equipment and/or use of crane(s)?	Y	N	N/A
Comments:			
Will the work require the use of scaffolding?	Y	N	N/A
Comments:			
Will the work interrupt normal pedestrian or vehicular traffic?	Y	N	N/A
Comments:			
Will the work displace soiled linen or trash storage rooms?	Y	N	N/A
Comments:			
Please note... The information received in the PCRA will be included in the overall assessment, MUHC Infection Control complete an ICRA that will designate the installation of any required construction or infection control barriers that may be required.			

Work request must be properly submitted and **APPROVED with documents issued via Soleran System** prior to commencement of building demolition, construction, renovation, planned system outages, and facility maintenance work as defined in the following document: *MU Health Care - Construction, Renovation, Maintenance Risk Management – Policy.*

- Request shall be submitted as soon as possible to begin processing and allow full vetting.
- Submissions are preferred at minimum Three (3) working days prior to date for work to begin.
- No request will be approved with less than twenty-four (24) hours' notice unless approved by Executive Director of Support Services.

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Demolition and removal of existing portions of building as designated or required to provide for New Work. Refer to demolition drawings and notes. Work includes, but is not limited to the following:
 - 1. Architectural elements.
 - a. Demolition of interior materials and systems. Interior partitions, ceilings, doors, frames, and finishes as indicated on Drawings.
 - b. Demolition of exterior materials and systems. Face brick, sheathing, framing, and site elements.
 - 2. Structural elements. None.
 - 3. MEP/FP elements. As indicated on Drawings.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from the surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

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

1.5 PREINSTALLATION MEETINGS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Pre-demolition Photographs or Video: Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerants, stating that all refrigerants that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

SELECTIVE DEMOLITION

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1.8 QUALITY ASSURANCE

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

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials, if any, will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.
 - 1. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

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

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
 4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain adequate ventilation when using cutting torches.
 - 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 6. Maintain fire watch during and for at least four hours after flame-cutting operations.
 - 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 8. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site and designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
 - 2. Carefully remove vinyl base where indicated and/or required to prevent damage to wall surfaces that are scheduled to remain. Before removal of wall base score a joint between base and painted surface. Insert large putty knife between base and wall surface to separate base from wall. Do not pull base directly from wall without using the above procedures.

3.7 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

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SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** .
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - 2. Review **[special inspection and testing and inspecting agency procedures for field quality control,] [concrete finishes and finishing,] [cold- and hot-weather concreting procedures,] [curing procedures,], [vapor-retarder installation,] [steel reinforcement installation,] [floor and slab flatness and levelness measurement,] [concrete repair procedures,]** and concrete protection.

Cast-in-Place Concrete

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1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [manufacturer] [testing agency].
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Fiber reinforcement.
 - 5. Curing compounds.
 - 6. Floor and slab treatments.
 - 7. Bonding agents.
 - 8. Adhesives.
 - 9. Vapor retarders.
 - 10. Semirigid joint filler.
 - 11. Joint-filler strips.
 - 12. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Aggregates[: **Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity**].
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

- E. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency,[**acceptable to authorities having jurisdiction,**] qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.[**Avoid damaging coatings on steel reinforcement.**]

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below **40 deg F (4.4 deg C)** for three successive days, maintain delivered concrete mixture temperature within the temperature range required by **ACI 301 (ACI 301M)**.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with **ACI 301 (ACI 301M)** and **ACI 305.1 (ACI 305.1M)**, and as follows:
1. Maintain concrete temperature below **90 deg F (32 deg C)** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. **ACI 301 (ACI 301M)**.
 2. **ACI 117 (ACI 117M)**.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
 3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, [Type I/II]
 - 2. Fly Ash: ASTM C 618, [Class F or C].
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

- C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: [**1 inch (25 mm)**] nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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.
- F. Water: ASTM C 94/C 94M[**and potable**].

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than **10 mils (0.25 mm)** thick.

2.7 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.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: [**ASTM D 1751, asphalt-saturated cellulosic fiber**] [**or**] [**ASTM D 1752, cork or self-expanding cork**].
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [**epoxy resin with a Type A shore durometer hardness of 80**] [**aromatic polyurea with a Type A shore durometer hardness range of 90 to 95**] according to ASTM D 2240.

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- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. **[Types I and II, nonload bearing]** for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than **0.022-inch- (0.55-mm-)** thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/4 inch (6.4 mm)** and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch (3.2 to 6 mm)** or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than **[5000 psi (34.5 MPa)]** at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to **ACI 301 (ACI 301M)**.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials:**[Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.] [Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:]**
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Slag Cement: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to **[0.06] [0.15] [0.30] [1.00]** **<Insert number>** percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use **[water-reducing] [high-range water-reducing] [or] [plasticizing]** admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Slabs-on-Grade: Normal-weight concrete.
1. Minimum Compressive Strength: **[5000 psi (34.5 MPa)]** at 28 days.
 2. Maximum W/C Ratio: **[0.50]**
 3. Minimum Cementitious Materials Content: **[470 lb/cu. yd. (279 kg/cu. m)] [520 lb/cu. yd. (309 kg/cu. m)] [540 lb/cu. yd. (320 kg/cu. m)]**.
 4. Slump Limit: **[4 inches (100 mm)] [5 inches (125 mm)] [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)**.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 6. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of **[50 lb/cu. yd. (29.7 kg/cu. m)]**

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M[, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (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.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), 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 (ACI 117M).
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. [Class B, 1/4 inch (6 mm)] for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.

- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. [Chamfer] exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for [24] hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved[**at least 70 percent of** its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR-RETARDER INSTALLATION

- 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.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset

laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780/A 780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.6 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.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 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. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch (3.2 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. 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 does 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.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than **1/2 inch (13 mm)** or more than **1 inch (25 mm)** below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of **ACI 301 (ACI 301M)**.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to **ACI 301 (ACI 301M)**.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches (150 mm)** into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.

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5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.8 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**]

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, 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 restraighen 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 all interior locations.
2. Finish surfaces to the following tolerances, according to **ASTM E 1155 (ASTM E 1155M)**, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. 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 [**1/4 inch (6 mm)**] [**3/16 inch (4.8 mm)**] [**1/8 inch (3.2 mm)**].

- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases [6 inches (150 mm)] high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: [5000 psi (34.5 MPa)] at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 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 305.1 (ACI 305.1M) 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after

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loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (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.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer[**unless manufacturer certifies curing compound does 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.

3.12 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than **[14]** days' old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.
- C. Apply at entirety of slab of Elec SE201F

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least **[one]** month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches (50 mm)** deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 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.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a **No. 16 (1.18-mm)** sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch (13 mm)** in any dimension to solid concrete. Limit cut depth to **3/4 inch (19 mm)**. Make edges of cuts perpendicular to concrete surface. Clean, dampen with

- water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of **0.01 inch (0.25 mm)** wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of **1/4 inch (6 mm)** to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes **1 inch (25 mm)** or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a **3/4-inch (19-mm)** clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes **1 inch (25 mm)** or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a **[special inspector]** **[and]** **[qualified testing and inspecting agency]** to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding **5 cu. yd. (4 cu. m)**, but less than **25 cu. yd. (19 cu. m)**, plus one set for each additional **50 cu. yd. (38 cu. m)** or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each **100 cu. yd. (76 cu. m)** or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; **[ASTM C 173/C 173M, volumetric method, for structural lightweight concrete;]** one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure [two] sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- E. Measure floor and slab flatness and levelness according to **ASTM E 1155** (**ASTM E 1155M**) within **[48]** hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 07 84 13 - PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies, if any.
 - 3. Penetrations in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Samples: For each firestopping label and fire/smoke partition identification graphic label or stencil to be used in the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Qualification Data: For Installer.
- C. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.
- D. Manufacturer's written installation instructions for each type of firestopping product used in the Work.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- B. Provide closeout documents as outlined in the Firestop Contractors International Association (FCIA) "Manual of Standard Practice" (current edition). Furnish to Owner at Substantial Completion.

1.7 QUALITY ASSURANCE

- A. Manufacturer to provide qualified technical personnel on site during beginning of installation of each type of firestopping system to verify proper system selection and installation procedures and compliance with manufacturer's written recommendations and drawing details. Product distributors or agent are not considered qualified technical personnel.
- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements" and is experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
 - 1. Installer must be a member in good standing of the Firestop Contractors International Association (FCIA).
- C. Comply with requirements and recommendations of the Firestop Contractors International Association (FCIA) "Manual of Standard Practice" (current edition).
- D. **Installation Responsibility: Assign installation of all penetration firestopping and joint firestopping in this Work to a single qualified installer.**

1. Individual subcontractors are responsible for reporting to the General Contractor all penetrations made by their respective trades, in walls, ceilings, floors, shafts, and other parts of the building construction, whether made in new or existing construction. Firestopping is required to maintain fire, smoke or other required ratings or qualities of the penetrated construction.
2. The General Contractor and individual subcontractors are responsible for reporting any existing penetrations in walls, ceilings, floors, shafts and other parts of the building construction discovered while uncovering in-place work. Subcontractors are required to report to the General Contractor. The General Contractor is required to report to the Architect for direction.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.
- C. Notify testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

- 1) UL in its "Fire Resistance Directory."
- 2) FM Global in its "Building Materials Approval Guide."

B. Source Limitations: Obtain penetration firestopping systems, for each kind of penetration and construction condition indicated, from a single primary firestopping systems manufacturer.

1. Proprietary products that are from a different manufacturer and required by construction documents and/or jobsite conditions will be considered in accordance with Section 01 25 00 "Substitution Procedures."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist the spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Allowable Manufacturers:

- a. Hilti, Inc.
- b. STI
- c. 3M

B. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

C. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

D. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

E. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
 - G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:
 1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
 - H. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - I. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant ad-

ditives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and non-sag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of non-sag grade for both opening conditions

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete, if any.
- B. Prime substrates where recommended in writing by manufacturers using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.2 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- E. Start installation of joint firestopping in the presence of firestopping manufacturer's technical personnel.

3.3 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.4 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

SECTION 078443 - JOINT FIRESTOPPING

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. Joints in or between fire-resistance-rated constructions.
 - 2. Joints in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
 - 2. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Samples: For each firestopping label and fire/smoke partition identification graphic label or stencil to be used in the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.
- C. Manufacturer's written installation instructions for each type of firestopping product used in the Work.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- B. Provide closeout documents as outlined in the Firestop Contractors International Association (FCIA) "Manual of Standard Practice" (current edition). Furnish to Owner at Substantial Completion.

1.7 QUALITY ASSURANCE

- A. Manufacturer to provide qualified technical personnel on site during beginning of installation of each type of firestopping system to verify proper system selection and installation procedures and compliance with manufacturer's written recommendations and drawing details. Product distributors or agent are not considered qualified technical personnel.
- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements" and a firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
 - 1. Installer must be a member in good standing of the Firestop Contractors International Association (FCIA).
- C. Comply with requirements and recommendations of the Firestop Contractors International Association (FCIA) "Manual of Standard Practice" (current edition).
- D. Installation Responsibility: Assign installation of all penetration firestopping and joint firestopping in this Work to a single qualified installer.

1. Individual subcontractors are responsible for reporting to the General Contractor all penetrations made by their respective trades, in walls, ceilings, floors, shafts, and other parts of the building construction, whether made in new or existing construction. Firestopping is required to maintain fire, smoke or other required ratings or qualities of the penetrated construction.
2. The General Contractor and individual subcontractors are responsible for reporting any existing penetrations in walls, ceilings, floors, shafts and other parts of the building construction discovered while uncovering in-place work. Subcontractors are required to report to the General Contractor. The General Contractor is required to report to the Architect for direction.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside the limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate the sizing of joints to accommodate joint firestopping systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

- B. Source Limitations: Obtain joint firestopping, for each kind of joint and construction condition indicated, from a single primary firestopping systems manufacturer.
1. Proprietary products that are from a different manufacturer and required by construction documents and/or jobsite conditions will be considered in accordance with Section 01 25 00 "Substitution Procedures."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist the spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. Allowable Manufacturers:
- a. Hilti, Inc.
- b. STI
- c. 3M
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
1. Basis-of Design Manufacturers: Subject to compliance with requirements, provide products by the following:
- a. Hilti, Inc.
2. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- F. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. Start installation of joint firestopping in the presence of firestopping manufacturer's technical personnel.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

JOINT FIRESTOPPING

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- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

- B. Related Requirements:

1. Section 07 92 19 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field-Adhesion-Test Reports: For each sealant application tested.
- E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period:
 - a. Silicone Sealants: **20** years from date of Substantial Completion.

- b. Other Sealants: 5 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturers, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
 - 1. Architectural sealants shall have a VOC content of 250 g/L or less.
 - 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
 - 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. **Silicone, Nonstaining, S, NS, 100/50, T, NT:** Nonstaining, single-component, non-sag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide the following:
 - a. Dow Corning Corporation; 790.

2.3 URETHANE JOINT SEALANTS

- A. **Urethane, S, NS, 25, NT:** Single-component, non-sag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. BASF Construction Chemicals, LLC, Building Systems; Sonalastic TX1.
- b. Bostik, Inc.; Chem-Calk GPS1, 900, 915, 916 or 2000.
- c. ER Systems, an ITW Company; Pacific Polymers Elasto-Thane 230 MP.
- d. Pecora Corporation; Dynatrol I-XL.
- e. Polymeric Systems, Inc.; Flexiprene 1000.
- f. Schnee-Morehead, Inc., an ITW company; Permthane SM7108.
- g. Sherwin-Williams Company (The); Stampede-1 or Stampede-TX.
- h. Sika Corporation U.S.; Sikaflex Textured Sealant.
- i. Tremco Incorporated; Dymonic.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. **Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT:** Mildew-resistant, single-component, non-sag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; 786-M White.
- b. GE Construction Sealants; SCS1700 Sanitary.
- c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
- d. Soudal USA; RTV GP.
- e. Tremco Incorporated; Tremsil 200.

2.5 BUTYL JOINT SEALANTS

- A. **Butyl-Rubber-Based Joint Sealants:** ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Bostik, Inc.; Chem-Calk 300.
- b. Pecora Corporation; BC-158.

2.6 LATEX JOINT SEALANTS

- A. **Acrylic Latex:** Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
 - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600 or Bondaflex Sil-A 700.
 - c. Pecora Corporation; AC-20.
 - d. Sherwin-Williams Company (The); 850A, 950A or PowerHouse.
 - e. Tremco Incorporated; Tremflex 834.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturers based on field experience and laboratory testing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturers for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturers where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

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 performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturers or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact

or by cleaning methods required to remove sealant smears. Remove the tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturers' written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturers and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - a. Use masking tape where necessary to protect surfaces adjacent to tooled joints.

3.4 FINAL FINISHING

- A. Where sealants are installed against one or more painted surfaces, paint over installed sealant to match adjacent painted surface. Such locations include joints between hollow metal frames and surrounding walls and countertops or window stools and surrounding walls.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete floors.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: **Silicone, nonstaining, S, NS, 100/50, T, NT.**
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Expansion joints on exposed interior surfaces of exterior walls.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: **Urethane, S, NS, 25, NT.**
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: **Acrylic latex.**
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: **Silicone, mildew resistant, acid curing, S, NS, 25, NT.**
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Other joints as indicated on Drawings.
 2. Joint Sealant: **Butyl-rubber based.**
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non-acoustical applications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each acoustic joint sealant.
- B. Samples: For each kind and color of acoustic joint sealant required.
- C. Acoustic-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustic joint sealant, for tests performed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustic joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: **Two** years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

- 1. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustic joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
- B. VOC Content of Interior Sealants: Sealants and sealant primers shall comply with the following:
 - 1. Acoustic sealants and sealant primers shall have a VOC content of 250 g/L or less.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Acoustic Sealant for Concealed Joints: Manufacturer's standard non-sag, nondrying, nonhardening, non-skinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
- C. Primer: Material recommended by acoustic-joint-sealant manufacturers where required for adhesion of sealant to joint substrates.
- D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- E. Masking Tape: Nonstaining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive acoustic joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustic joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustic-joint-sealant manufacturer.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with the acoustic joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustic joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustic ceilings.
- C. Acoustic Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustic joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such

protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustic joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 19

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.
 - 3. Interior custom hollow-metal doors and frames.
 - 4. Exterior custom hollow-metal doors and frames.
- B. Related Requirements:
 - 1. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
 - 2. Section 083463 "Detention Doors and Frames" for hollow-metal doors and frames for detention facilities.
 - 3. Section 083473.13 "Metal Sound Control Door Assemblies" for packaged, acoustically rated hollow-metal door and frame assemblies.
 - 4. **[Section 087100 "Door Hardware"]** for door hardware for hollow-metal doors.
 - 5. Section 134900 "Radiation Protection" for lead-lined, hollow-metal doors and frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]**

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, **[fire-resistance ratings,]** **[temperature-rise ratings,]** and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of molding, removable stops, and glazing.
- C. Product Schedule: For hollow metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch- (102-mm-)** high wood blocking. Provide minimum **1/4-inch (6-mm)** space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld Building Products, LLC
 - 2. Ceco Door Products.
 - 3. Curries Company.
 - 4. Republic Doors and Frames.
 - 5. Pioneer
 - 6. Steelcraft.
 - 7. OR approved equal

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings [**and temperature-rise limits**] indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Limit: [**Where indicated**] provide doors that have a maximum transmitted temperature end point of not more than **450 deg F (250 deg C)** above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

- C. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996 for **[Wind Zone 4]**.
 - 1. Large-Missile Test: For glazed openings located within **30 feet (9.1 m)** of grade.
- D. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than **<U 0.700>** when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. **[At locations indicated in the Door and Frame Schedule] <Insert locations>**.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches (44.5 mm)**.
 - c. Face: **[Uncoated] [Metallic coated]** steel sheet, minimum thickness of **0.60 inch (16 ga)**
 - d. Edge Construction: **[Model 2, Seamless]**
 - e. Edge Bevel: **[Provide manufacturer's standard beveled or square edges]**.
 - f. Core: **Polyurethane] [Vertical steel stiffener]**.
 - g. Fire-Rated Core: Manufacturer's standard **[vertical steel stiffener] [laminated mineral board]** core for fire-rated **[and temperature-rise-rated] doors**.
 - 2. Frames:
 - a. Materials: **[Uncoated]** steel sheet, minimum thickness of **0.053 inch (1.3 mm)**.
 - b. Construction: **[Full profile welded]**.
 - 3. Exposed Finish: **[Prime]**

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A. **<At all locations where exterior hollow metal exterior doors are indicated on drawings>**.
 - 1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.060 inch (16 ga) with minimum [A60 (ZF180)] coating.
 - d. Edge Construction: [Model 2, Seamless].
 - e. Edge Bevel: [Provide manufacturer's standard beveled or square edges].
 - f. Top Edge Closures: Close the top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors [where required for attachment of weather stripping] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - a. Core: Polyurethane [Vertical steel stiffener].
 - b. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener with insulation] [laminated mineral board] core for fire-rated doors.
2. Frames:
- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.075 (14 gauge) with minimum [A60 (ZF180)] coating.
 - b. Construction: [Full profile welded].
3. Exposed Finish: [Prime

2.5 FRAME ANCHORS

- A. Jamb Anchors:
- 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 - 3. Post installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jam and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate the bottom of frames at top of underlayment.
- D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot dip galvanized according to ASTM A 153/A 153M, Class B.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend a minimum of **3/4 inch (19 mm)** beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

3. Terminated Stops: Terminate stops [6 inches (152 mm)] > above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
 3. Provide stops and moldings flush with face of door, and with [beveled] [square] stops unless otherwise indicated.
 4. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 5. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on the inside of hollow-metal doors and frames.
 6. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 7. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with the manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with **[SDI A250.11]** **[NAAMM-HMMA 840]**.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with post installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. **[Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.]**
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with **[SDI A250.8]** **[NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated]**.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.

3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Section 08 11 13 "Hollow Metal Frames".
 - 2. Section 08 71 00 "Door Hardware" for hardware installed at flush wood doors.
 - 3. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, and trim for openings. Include factory-finishing specifications.
- B. Templates: Coordinate with Door Hardware Supplier and with requirements in Section 08 71 00 "Door Hardware." Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the flush wood door supplier in order to prepare the doors to receive the finish hardware items.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.

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5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.
 - b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Section 1300, Premium Grade.
- B. Finish doors in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Section 1500, grades identified in schedule.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- D. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with AWI P-200, Section 1300.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.

- C. Protect door with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer. Break seal on site to permit ventilation.
- D. Store doors at site, stacked in a vertical position, spaced with a minimum of 1/4 inch space between each stacked door and on a minimum 4 inch high wood blocking.

1.8 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

- A. Warrant door against warp or twist in excess of 1/4 inch in any face including full diagonal. Replacement shall include finishing of new door, hardware damaged by malfunction of original door, and hanging in satisfactory operating condition. Period of warranty shall be 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

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Ampco
 - 3. Assa Abloy
 - 4. Construction Specialties, Inc.
 - 5. Marshfield Door System, Inc.
 - 6. Poncraft Door Co.
 - 7. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors".
 - 1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- C. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.
 - 2. Extra Heavy Duty: At the following locations and where indicated.
 - a. Treatment Room
 - b. Public Bathroom
 - c. Stair/Exit
 - d. Housekeeping
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- F. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- G. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).

H. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.

B. Basis-of-Design: Subject to compliance with requirements, provide the following or a comparable product by another manufacturer listed herein.

1. Basis-of-Design: Architect's sample:
 - a. Manufacturer: **Masonite Architectural.**
 - b. Wood Species: **Oak**
 - c. Cut: Quarter SLiced.
 - d. Finish Custom Color: **Match existing adjacent doors**
2. Match between Veneer Leaves: Book match.
3. Assembly of Veneer Leaves on Door Faces: Center-balance match.
4. Pair and Set Match: Provide for doors hung in same opening or separated only by Mullions.
5. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet (6 m) or more.
6. Exposed Vertical Edges: Same species as faces or a compatible species - edge Type A.
7. Core: Either glued wood stave or structural composite lumber.
 - a. Fire Rated Doors: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.

8. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Match profile of existing wood doors in project area.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: To match existing adjacent doors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

FLUSH WOOD DOORS

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CRMC Switchgear Replacement
Project #CP252301

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire Project from one source and from one manufacturer.
- B. Fire-Resistance Ratings: Fire-Resistance Ratings: Wherever access doors are required in construction where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.'s "Building Materials Directory" for rating shown.
 - 1. Provide UL label on each fire-rated access door.
- C. Size Variations: Provide manufacturer's standard sizes. Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- D. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames, including types, locations, sizes, latching provisions, and other data pertinent to installation. Use same room designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES GENRAL

- A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis.
 - 3. J.L. Industries.
 - 4. Larsens Manufacturing Company
 - 5. MIFAB, Inc.
 - 6. Milcor
 - 7. Nystrom, Inc.

2.3 NON FIRE-RATED ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
 - 1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
 - 2. Locations: Wall and ceiling.
 - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
 - 4. Frame Material: Same material and thickness as door.
 - 5. Latch and Lock: Cam latch, screwdriver operated.

2.4 FIRE-RATED ACCESS DOORS AND FRAMES

- A. Fire-Rated, Flush Access Doors with Concealed Flanges:
 - 1. Description: Door face flush with frame, uninsulated; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
 - 2. Locations: Wall and ceiling.
 - 3. Fire-Resistance Rating: Not less than that of adjacent construction.
 - 1. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
 - 2. Frame Material: Same material and thickness as door.
 - 3. Latch and Lock: Self-closing, self-latching door hardware, operated by knurled-knob, with interior release.

2.5 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.6 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review locations required for access doors with installers of equipment, controls, and other miscellaneous devices requiring access after completion of construction activities. Document access panel locations and sizes in schedule indicated under "Submittals" article.

- B. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 71 00 - DOOR HARDWARE

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. Intent: The intent of this Section is to provide finish hardware for the proper operation and control of all doors in the Project. Prior to bidding, notify the Architect of any doors that do not have hardware meeting this intention.
- B. Provide all items of finish hardware required to adequately trim, hang, and operate all doors as is hereinafter specified and listed in the Hardware Schedule.
 - 1. The hardware supplier will be responsible to furnish correct hardware on labeled doors to satisfy State and Local Building Codes.
 - 2. Should items of hardware not definitely specified be required for completion of work, including any existing doors indicated to remain, furnish such items of type and quality suitable to the services required and comparable to the adjacent hardware.
 - 3. Provide all necessary standard and special fasteners, screws, bolts, expansion shields or anchors to properly secure hardware to its intended door, frame, or other surface, including items required for reinstallation of any salvaged existing hardware indicated to be reinstalled.
- C. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
- D. This Section includes, but is not necessarily limited to furnishing complete, the following:
 - 1. Finish hardware for proper operation, function, control and protection of all doors, as required.
- E. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

- F. Permanent lock cores to be installed by Owner.
- G. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure difference.
 - 3. ICC/IBC - International Building Code.
 - 4. NFPA 70 - National Electrical Code.
 - 5. NFPA 80 - Fire Doors and Windows.
 - 6. NFPA 101 - Life Safety Code.
 - 7. NFPA 105 - Installation of Smoke Door Assemblies.
- H. Standards: All hardware specified herein shall comply with the following industry standards:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Inspect and discuss preparatory work performed by other trades.
 - 4. Inspect and discuss electrical roughing-in for electrified door hardware.
 - 5. Review sequence of operation for each type of electrified door hardware.

6. Review required testing, inspecting, and certifying procedures.
- B. Keying Conference: Conduct conference at Project site to review the owner provided cylinders and locations for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Provide a catalog cut sheet, clearly marked and identified, illustrating and describing each product included in the Hardware Schedule.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Organize catalog cut sheets into sets and include a set with each copy of the Hardware Schedule submitted.
- B. Samples for Verification: For each type of exposed product, in each finish specified.
1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheets and 4-inch (102-mm) long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
 2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing fabrication and assembly of door hardware as well as procedures and diagrams. Coordinate the door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Use same door numbers as in door hardware schedule in the Contract Documents.
 3. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 4. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.

- b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. Door and frame sizes and materials.
 - i. List of related door devices specified in other Sections for each door and frame.
- D. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents. Owner to approve submitted keying schedule prior to the ordering of cylinders.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 - 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturers and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Provide the latest, revised and updated schedule of finish hardware, complete with catalog cuts and keying schedule. Provide in quantity required in Section 01 78 23 "Operation and Maintenance Data."
 - 1. Include maintenance and parts manuals.
 - 2. Include name, address, and contact information of the manufacturers providing the hardware and the nearest service representatives.

3. Include 'as-built' modifications made during installation, checkout and acceptance.
- B. Schedules: Final door hardware and keying schedule.
 - C. Schedule of maintenance service specified elsewhere in this Section. Include proposed dates for service and service contact information for use by Owner.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Openings Consultant (AOC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner by registered mail or overnight package service as established during keying conference.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.

- b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
- 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Manual Closers: 25 years from date of Substantial Completion.
 - b. Heavy Duty Bored Locks and Latches: Seven years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from a single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable. Electrical modifications or enhancements made to a source manufacturer's product line by a secondary or third-party source are not acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

DOOR HARDWARE

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1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 1. Door hardware is scheduled in Part 3 and on Drawings.
 2. Door Hardware Sets: Provide quantity, item, size, finish or color indicated and named manufacturers' products or products equivalent in function and comparable in quality to named products and complying with BHMA designations referenced.
 - a. Provide manufacturer's standard products meeting the design intent of this Specification, free of imperfections affecting appearance or serviceability.
 - b. Substitutions: Refer to Section 01 25 00 "Substitution Procedures."
 3. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 4. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 1. Provide non-removable pins for all out-swinging exterior doors. Use non-rising pins for all other doors. Provide continuous hinge at exterior doors where specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Bommer Industries, Inc.
 - c. Hager Companies.
 - d. McKinney Products Company; an ASSA ABLOY Group company.

2.5 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pin-less, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Bommer Industries, Inc.
 - c. Roton; Hager Companies.
 - d. McKinney Products Company; an ASSA ABLOY Group company.

2.6 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for the length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latch bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated in Part 3 Door Hardware Schedule to match Hospital standard.
 - 2. Levers: Wrought, forged or cast.
 - 3. Escutcheons (Roses): Wrought, forged or cast.
 - 4. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latch bolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latch bolts, as recommended by manufacturer.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000. Provide non-handed, field reversible units.
 - 1. Manufacturers: Per scheduled door hardware.

2.7 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. To match facility standard Best 1C7:
 - a. Owner to provide cylinders
- B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.8 KEYING

- A. Keying System: The owner is to provide the cores and keys.

2.9 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. LCN Closers; an Allegion company. NO SUBSTITUTES

2.10 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Architectural Builders Hardware Mfg., Inc.
 - c. Baldwin Hardware Corporation.
 - d. Burns Manufacturing Incorporated.
 - e. Cal-Royal Products, Inc.
 - f. Don-Jo Mfg., Inc.
 - g. Door Controls International, Inc .
 - h. Hager Companies.
 - i. Hiawatha, Inc.; a division of the Activar Construction Products Group.
 - j. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
 - k. Trimco.

2.11 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Architectural Builders Hardware Mfg., Inc.
 - c. Glynn-Johnson; an Allegion company.
 - d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - e. Sargent Manufacturing Company; an ASSA ABLOY Group company.

2.12 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. M-D Building Products, Inc.
 - c. National Guard Products.
 - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - e. Reese Enterprises, Inc.
 - f. Sealeze; a unit of Jason Incorporated.
 - g. Zero International.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.13 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Baldwin Hardware Corporation.

- c. Cal-Royal Products, Inc.
- d. Don-Jo Mfg., Inc.
- e. Hager Companies.
- f. Rockwood Manufacturing Company.
- g. Trimco.

2.14 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames use threaded-to-the-head wood screws for wood doors.
 - 2) Strike plates to frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Closers to doors and frames.
 - 2) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Antimicrobial Finishes: Unless otherwise specified, finishes on locksets, latch sets, exit devices and push/pull trim to incorporate an FDA recognized, Silver Ion, antimicrobial coating (Micro Shield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Frames: For surface-applied door hardware, drill and tap frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores provided by owner and as directed by the owner.
- E. Stops: Provide wall stops for doors unless floor or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- F. Gasketing, General: Remove and replace any damaged existing gasketing with new gasketing for a complete installation complying with requirements indicated for a new installation.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame at openings indicated.
 - a. Do not notch perimeter gasketing to install other surface-applied hardware.
 - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier's Hardware Consultant will perform inspections and prepare inspection reports.

1. Supplier's Hardware Consultant will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six months after the date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at the time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturers' authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

A. Although the following Hardware Schedule is intended to cover all doors and to establish a type and standard of quality, it shall be the specific duty and responsibility of the Door Hardware Supplier and their Architectural Hardware Consultant to examine the Contract Documents and furnish the proper hardware for all openings, whether scheduled or not.

B. Hardware Legend

1. IV - Ives
2. VO - Von Duprin
3. BE - BEST Locks & Closers
4. LC - LCN Closers
5. HA - Hager
6. ZE - Zero International
7. SH - Schlage Electronic Security

C. Hardware Schedule

Hardware Sets

Set: 01

Doors: [SE201F.1](#)

3 Hinge, Full Mortise	5BB1 4-1/2" x 4-1/2" NRP	652	IV
1 Rim Exit Nightlatch	99L-NL-F x 996L-NL x 17	.626	VO
1 Cylinder/Core	as required	626	BE
1 Surface Closer	4040XP SCUSH	.689	LC
1 Kick Plate	8400 10" x 2" LDW B-CS	US32D	IV
1 Gasketing	188S verify color		ZE

Set: 02

Doors: [SE201F.2](#)

1 Continuous Hinge	224XY	628	IV
1 Rim Exit Nightlatch	99NL-OP x 110MD-NL x 4'	.626	VO
1 Vandal Resistant Trim	VR910-NL	630	IV
1 Cylinder/Core	as required	626	BE
1 Surface Closer	4040XP SCUSH	.689	LC
1 Rain Drip	142AA		ZE
1 Gasketing	429AA		ZE
1 Sweep	8197AA		ZE
1 Threshold	656A		ZE

DOOR HARDWARE

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1 Door Position Switch	679-05HM		SH

Set: 03

Doors: [SE205A.1](#)

3 Hinge, Full Mortise, Hvy Wt	5BB1HW 5" x 4-1/2" NRP	652	IV
1 Rim Exit Nightlatch	99L-NL.F x 996L-NL x 17 x 4'	.626	VO
1 Cylinder/Core	as required	626	BE
1 Surface Closer	4040XP SCUSH	.689	LC
1 Kick Plate	8400 10" x 2" LDW B-CS	US32D	IV
1 Gasketing	188S verify color		ZE

END OF SECTION 08 71 00

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes non-loadbearing steel framing members for the following applications:
 - 1. Interior framing systems as supporting elements for partitions, framed soffits, furring, etc.
 - 2. Interior suspension systems as supporting elements for ceilings, suspended soffits, etc.
 - 3. Interior grid suspension systems for gypsum board ceilings.
- B. For suspended acoustical ceiling systems, refer to Section "09 61 13 "Acoustical Panel Ceilings".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C 754.
- B. Installer Qualifications: Company specializing in performing the work of this section with a minimum of five years documented experience and approved by manufacturer.

1.6 PROJECT CONDITIONS

- A. Coordinate the placement of components to be installed within and attached to the stud framing system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for the conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
 - 1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. MarinoWARE
 - b. Phillips Manufacturing Company
 - c. SCAFCO Steel Stud Company
 - d. The Steel Network, Inc.
 - 2. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection, but no less than 20 gauge, 0.0329 inch (0.836 mm).
 - 3. Depth: 3-5/8 inches (92 mm), unless otherwise indicated.
- C. Slip-Type Head Joints: Where indicated, provide **the** following:

1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products/Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1) MarinoWARE.
 - 2) Phillips Manufacturing Company.
 - 3) SCAFCO Steel Stud Company; SCAFCO Slotted Leg Track System.
 - 4) The Steel Network, Inc.; VertiClip SLD or VertiTrack VTD.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ClarkDietrich; BlazeFrame or MaxTrak.
 - b. Fire Trak Corp; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - c. MarinoWARE.
 - d. SCAFCO Steel Stud Company; SCAFCO Slotted Leg Track System.
 - e. The Steel Network, Inc.; VertiTrack VT.
- E. Flat Strap: Steel sheet for blocking and bracing in length and width indicated.
 1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. SCAFCO Steel Stud Company.
 1. Minimum Base-Metal Thickness: 0.0329 inches (0.836 mm).
- F. Backing Plate: Galvanized steel plate for blocking and bracing in length and width indicated and as necessary to accommodate wall-mounted and wall-supported items including but not limited to casework, millwork, railings, wall protection, equipment, medical equipment, artwork, signage, etc.
 1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. ClarkDietrich Building Systems
 - b. MarinoWARE
 - c. SCAFCO Steel Stud Company
 2. Minimum Base-Metal Thickness: 0.0538-inch (1.367-mm).

3. Provide plates designed, and certified, to support an imposed load of 250 lbs. per linear foot for handrails, grab bars and other ADA-compliant items. Provide plates designed, and certified, to support an imposed load of 144 lbs. per linear foot for all other items. All loads required above are in addition to the weight of the item supported by the back-up plate.
 4. Provide plates designed for screw-attachment to steel studs with back-up plate faces flush with face of studs or overlapping face of studs with pre-cut notches matching stud spacing.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. SCAFCO Steel Stud Company.
 2. Depth: 1-1/2 inches (38 mm).
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. SCAFCO Steel Stud Company.
 2. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 3. Depth: 7/8 inch (22.2 mm).
- I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Acceptable Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include:
 - a. ClarkDietrich Building Systems.
 - b. MarinoWARE.
 - c. SCAFCO Steel Stud Company.
 2. Configuration: Asymmetrical or hat shaped.
- J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete: Coordinate anchoring requirements with supporting conditions and with Owner, Architect and Engineer.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 2-1/2 inches (64 mm).
- E. Furring Channels (Furring Members):
 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 - b. Depth: As indicated on Drawings.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.

- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armstrong World Industries, Inc; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; 640/660 Drywall Ceiling Suspension.
 - c. United State Gypsum Company; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.

- 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

- B. Isolation Strip at Exterior Walls: Provide one of the following:

- 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

- C. Acoustic Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

- D. Sound Batt Insulation: As specified in Section 09 29 00 "Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, including welded hollow-metal frames, anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Remove existing only to extent necessary for installation of non-load-bearing steel framing. Do not reduce the thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

1. Install flat strap bracing in widths and lengths indicated or, if not indicated, 6-inches (152-mm) wide and spanning a minimum of three studs.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

1. Coordinate framing with control joints indicated on drawings and as specified in Section 09 29 00 "Gypsum Board."

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Space studs at 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood blocking.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
1. Install hangers' plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counterplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to the steel roof deck.
 5. Do not attach hangers to permanent metal forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

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. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 07 84 43 "Joint Firestopping" for fire resistant infill at top of walls at metal deck flutes.
 - 2. Section 07 92 19 "Acoustical Joint Sealants" for acoustical joint sealants installed at gypsum board.
 - 3. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Comply with published recommendations of gypsum board product manufacturers and with Gypsum Association's GA-216 "Application and Finishing of Gypsum Panel Products," latest edition, unless more stringent requirements are indicated. Refer to these publications for terms not otherwise defined in this Section or in other referenced standards.
- B. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:

- a. Each level of gypsum board finish indicated for use in exposed locations.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE and HANDLING

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging. Gypsum boards shall not be stored in direct contact with concrete slabs.
- C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or Gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
 1. Fire-Resistance-Rated Assemblies: As indicated on Drawings by design designations from UL's "Fire Resistance Directory" or GA-600, "Fire Resistance Design Manual."

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

- 1. STC-Rated Assemblies: As indicated on Drawings by design designations from GA-600, "Fire Resistance Design Manual."

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with the support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. General. Gypsum board panels complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

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

- a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Building Products.
 - d. National Gypsum Company.
 - e. USG Corporation.

- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

- 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.

- C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

- 1. Thickness: 1/4 inch (6.4 mm).
 - 2. Long Edges: Tapered.

- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

- 1. Thickness: 1/2 inch (12.7 mm).
 - 2. Long Edges: Tapered.

- E. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

- 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.

GYPSUM BOARD

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3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.: Use at outside corners, unless otherwise indicated.
 - b. LC-Bead (J-Bead): Both face and back flanges; face flange formed to receive joint compound. Use at typical exposed panel edges.
 - 1) 200-A Metal Trim; USG or approved equal by another named manufacturer.
 - c. L-Bead: Face flange only; face flange formed to receive joint compound. Use only where indicated.
 - 1) 200-B Metal Trim; USG or approved equal by another named manufacturer.
 - d. U-Bead: Face flange formed to be left without application of joint compound. Use only where indicated.
 - 1) 400 Series Metal Trim; USG or approved equal by another named manufacturer.
 - e. Expansion (Control) Joint: Use where indicated.
 - f. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT AND FINISH MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 1. Laminating adhesive shall have a VOC content of 50 g/L or less.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Provide full thickness of stud cavity and as required for STC rating and tested wall assembly indicated.
 2. Sound-Attenuation blankets have maximum flame spread of 25 and smoke developed of 50 in accordance with ASTM E 84 or UL 723, and noncombustible passing ASTM E136 for combustion characteristics.
 3. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 4. Manufacturers and Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville, a Berkshire Hathaway Company; Sound-SHIELD Formaldehyde-Free Fibreglass Insulation Unfaced or Mineral Wool Sound Attenuation Fire Batts (SAFB).
 - b. Owens Corning; Sound Attenuation Batts Fiber Glass.
 - c. CertainTeed Corporation; CertaPRO AcoustaTherm Batts.
 - d. Thermafiber, Inc.; an Owens Corning company; Sound Attenuation Fire Blankets (SAFB).
- E. General Purpose Sealants: As specified in Section 07 92 00 "Joint Sealants."
- F. Acoustical Joint Sealant: As specified in Section 07 92 19 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling/soffit panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate support or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- H. Attach gypsum panels to framing provided at openings and cutouts.
- I. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and

trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- J. Attachment to Steel Framing: Attach panels so the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustic sealant. Install acoustic sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturers' written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustic ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Miscellaneous vertical surfaces indicated.
 - 2. Type X: Vertical surfaces unless otherwise indicated.
 - 3. Flexible Type: Apply in double layer at curved assemblies.
 - 4. Ceiling Type: Ceiling surfaces.
 - 5. Mold-Resistant Type: At walls containing a plumbing fixture, areas of high humidity, such as shower walls and ceilings, and at other locations indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 INSTALLING TRIM ACCESSORIES

- A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 at locations indicated on Drawings and as follows:
1. Install where a partition, wall, or ceiling traverses a construction joint (expansion, seismic or building control element) in the base building structure.
 2. Install where movement may occur at joints in a wall or partition supported by building systems that move differentially.
 3. Install where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear ft.
 4. Install in interior ceilings with perimeter relief so that linear dimensions between control joints do not exceed 50 ft and total area between control joints does not exceed 2,500 sq ft.
 5. Install in interior ceilings without perimeter relief so that linear dimensions between control joints do not exceed 30 ft and total area between control joints does not exceed 900 sq ft.
 6. Install where ceiling framing members change direction.
 7. Install at one side of door frames. Full height door frames shall be considered equivalent to a control joint.
 8. Install all control joints at specific locations approved by the Architect for visual effect and as indicated in the drawings.

- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate (typical exposed panel edge installation).
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 - 3. Install U-bead only where indicated.
 - 4. Curved-Edge Cornerbead: Use at curved openings.
- D. Sound-Attenuation Blankets: Install blankets in accordance with manufacturer's printed instructions, with tight joints in blanket units. Use tape, adhesive or staples to hold blankets in place.
 - 1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas and other concealed areas that are not fire/smoke/acoustically rated or serving as an air plenum and where indicated.
 - 2. Level 2: Panels that are substrates for paneling, above ceilings and other concealed areas where assembly is fire/smoke/acoustically rated or area serves as an air plenum and where indicated.
 - 3. Level 3: At panel surfaces that will be exposed to view and scheduled to receive a heavy wall covering finish, unless otherwise indicated.
 - 4. Level 4: At panel surfaces that will be exposed to view and scheduled to receive a paint or light wall covering finish, unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not

proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Owner and Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during the remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

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SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on **the following exterior substrates:**
 - 1. Steel and iron.
 - 2. Galvanized metal.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Sustainable Design Submittals:

- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches x 11 ½ inches.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: [5] percent, but not less than [1 gal. (3.8 L)] of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products manufactured by the Sherwin-Williams Company.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: **[As selected by Architect from manufacturer's full range**

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If

- paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. Portland Cement Plaster: 12 percent.
 6. Gypsum Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- 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.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.] [**but not less than the following:**]
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards[**and switch gear**].
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
- F. Paint Exterior Steel unfinished pipe bollards.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates:
 - 1. Water-Based Light Industrial Coating System[**MPI EXT 5.1B**] [**MPI EXT 5.1C**] [**MPI EXT 5.1M**] [**MPI EXT 5.1N**]:
 - a. Prime Coat: Primer, alkyd, anti-corrosive for metal[, **MPI #79**].
 - 1) B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer by Sherwin Williams
 - b. Prime Coat: Primer, rust inhibitive, water based[**MPI #107**].
 - 1) B66W1310 Pro Industrial Pro-Cryl Universal Primer by Sherwin Williams
 - c. Prime Coat: Primer, epoxy, anti-corrosive[**MPI #101**].
 - 1) B58W610 Macropoxy 646 Fast Cure Epoxy by Sherwin Williams

- d. Prime Coat: Shop primer specified in Section where substrate is specified.
 - e. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - f. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3)[, **MPI #161**].
 - 1) B66W1251 Pro Industrial DTM Acrylic Eg-Shel by Sherwin Williams
 - g. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #163**].
 - 1) B66W1151 Pro Industrial DTM Acrylic Semi-Gloss by Sherwin Williams
 - h. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6)[, **MPI #164**].
 - 1) B66W1051 Pro Industrial DTM Acrylic Gloss by Sherwin Williams
2. Alkyd System [**MPI EXT 5.1D**] [**MPI EXT 5.1Q**]:
- a. Prime Coat: Primer, alkyd, anticorrosive, for metal[, **MPI #79**].
 - 1) B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer by Sherwin Williams
 - b. Prime Coat: Shop primer specified in Section where substrate is specified.
 - c. Prime Coat: Primer, metal, surface tolerant[, **MPI #23**].
 - 1) B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer by Sherwin Williams
 - d. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - e. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5)[, **MPI #94**].
 - 1) B55W1101 Pro Industrial DTM Alkyd Semi-Gloss by Sherwin Williams
 - f. Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6)[, **MPI #9**].
 - 1) B54W151 Pro Industrial Urethane Alkyd Enamel by Sherwin Williams
3. Quick-Dry Enamel System[**MPI EXT 5.1A**]:
- a. Prime Coat: Primer, alkyd, quick dry, for metal[, **MPI #76**].
 - 1) B50WZ4 Kem Bond HS High Solids Alkyd Universal Metal Primer by Sherwin Williams

- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5)[, **MPI #81**].
 - 1) B55W1101 Pro Industrial DTM Alkyd Semi-Gloss by Sherwin Williams
- d. Topcoat: Alkyd, quick dry, gloss (MPI Gloss Level 7)[, **MPI #96**].
 - 1) B54W151 Pro Industrial Urethane Alkyd Enamel by Sherwin Williams

B. Galvanized-Metal Substrates:

- 1. Latex System [**MPI EXT 5.3A**] [**MPI EXT 5.3H**]:
 - a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - 1) B66W1310 Pro Industrial Pro-Cryl Universal Primer by Sherwin Williams
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1)[, **MPI #10**].
 - 1) A6W351 A-100 Exterior Latex Flat by Sherwin Williams
 - d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4)[, **MPI #15**].
 - 1) A82W351 A-100 Exterior Latex Satin by Sherwin Williams
 - e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5)[, **MPI #11**].
 - 1) A8W351 A-100 Exterior Latex Gloss by Sherwin Williams
 - f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6)[, **MPI #119**].
 - 1) B66W1051 Pro Industrial DTM Acrylic Gloss by Sherwin Williams
- 2. Water-Based Light Industrial Coating System [**MPI EXT 5.3G**] [**MPI EXT 5.3J**] [**MPI EXT 5.3K**]:
 - a. Prime Coat: Primer, galvanized, water based[, **MPI #134**].
 - 1) B66W1310 Pro Industrial Pro-Cryl Universal Primer by Sherwin Williams
 - b. Prime Coat: Primer, epoxy, anti-corrosive[, **MPI #101**].
 - 1) B58W610 Macropoxy 646 Fast Cure Epoxy by Sherwin Williams
 - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - d. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3)[, **MPI #161**].

- 1) B66W1251 Pro Industrial DTM Acrylic Eg-Shel by Sherwin Williams
- e. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5)[, **MPI #163**].
 - 1) B55W1101 Pro Industrial DTM Alkyd Semi-Gloss by Sherwin Williams
- f. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6)[, **MPI #164**].
 - 1) B66W1051 Pro Industrial DTM Acrylic Gloss by Sherwin Williams
3. Alkyd System[**MPI EXT 5.3B**]:
 - 1) Prime Coat: Primer, galvanized, water based[, MPI #134].
B66W1310 Pro Industrial Pro-Cryl Universal Primer by Sherwin Williams
 - 2) Intermediate Coat: Exterior, alkyd enamel, matching topcoat. Retain one of three "Topcoat" subparagraphs below.
 - 3) Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5)[, **MPI #94**].
 - 4) B55W1101 Pro Industrial DTM Alkyd Semi-Gloss by Sherwin Williams
 - 5) Topcoat: Alkyd, exterior, gloss (MPI Gloss Level 6)[, **MPI #9**].
 - 6) B54W151 Pro Industrial Urethane Alkyd Enamel by Sherwin Williams
4. Aluminum Paint System[**MPI EXT 5.3F**]:
 - 1) Prime Coat: Primer, galvanized, water based[, MPI #134].
 - 2) B66W1310 Pro Industrial Pro-Cryl Universal Primer by Sherwin Williams
 - 3) For a Premium Grade system, "MPI Manual" requires intermediate coat; delete "Intermediate Coat" Subparagraph below for a Budget Grade system.
 - 4) Intermediate Coat: Aluminum paint, matching topcoat.
 - 5) Topcoat: Aluminum paint[, **MPI #1**].
 - 6) B59S111 Silver-Brite Aluminum Paint by Sherwin Williams

END OF SECTION 099113

SECTION 09 91 23 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on interior substrates **(PT-*)**.
- B. Scope of Work.
 - 1. Finish interior surfaces exposed to view and without a factory finish, unless otherwise indicated.
 - a. Finish both faces and all edges of plywood backboards in electrical, mechanical, and telecommunication rooms.
 - b. Prime surfaces to receive wall coverings.
 - c. Mechanical and electrical equipment exposed to view in areas
- C. Related Requirements:
 - 1. Section 09 20 00 "Gypsum Board" for additional requirements for priming mineral based panels.

1.3 DEFINITIONS

- A. MPI Gloss Level 1 (Flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.

- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches x 11 ½".
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products manufactured by the Sherwin-Williams Company.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Products: Subject to compliance with requirements, provide products listed in the Interior Painting Schedule for the paint category indicated or comparable product from same MPI category and manufacturer.

INTERIOR PAINTING

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- C. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
 - 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 5. Pretreatment Wash Primers: 420 g/L.
- E. Colors: As indicated in a color schedule.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Gypsum Board: 12 percent.
 - 2. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

- D. Plaster Substrates: Verify that plaster is fully cured.
- 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.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 3.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
- F. At areas of disturbances where wall and or ceiling patching occurs, paint wall, soffits, or ceilings to nearest outside corners or inside corners. Walls to be painted from floor to ceiling. Ceilings and soffits to be painted to the nearest walls in all directions.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

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- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 IDENTIFICATION OF SPECIAL WALLS AND PARTITIONS

- A. General: Permanently label all special walls and partitions using stenciled lettering as follows:
 - 1. Stencil using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 2. Locate stenciling on both sides of wall or partition, in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 10 feet (3.05 m).
 - 3. In addition to above, locate stenciling at every change in direction of special walls and partitions.
 - 4. In addition to above, locate stenciling above each door in accessible concealed ceiling space.
 - 5. Indicate the end of special wall or partition condition with a 2-inch (51 mm) vertical red line with an arrow pointing in the direction of the special wall or partition construction.
 - 6. Stenciling Paint Color and Sheen: Red, semi-gloss.
- B. Fire and Smoke Walls and Partitions: Stencil identification with the following text, including applicable rating (example: "1 HR," "2 HR," "SMOKE BARRIER"):
 - 1. "(rating) FIRE and/or SMOKE BARRIER - PROTECT ALL OPENINGS."
 - 2. Coordinate labeling with Section 078413 "Penetration Firestopping" and Section 078443 "Joint Firestopping."

3.7 INTERIOR PAINTING SCHEDULE

- A. Egg Shell at Gypsum Board and Plaster Substrates:
 - 1. Latex over Latex Sealer System **MPI INT 9.2A**:
 - a. Prime Coat: Primer sealer, latex, interior, **MPI #50**.
 - 1) Basis-of-Design: B28W12600 ProMar 200 Zero VOC Interior Latex Primer by **Sherwin Williams**.
 - b. Topcoat: Latex, interior (MPI Gloss Level 3), **MPI #144**.
 - a) Basis-of-Design: B20W2951 ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel or A87W00061 SuperPaint Air Purifying Technology Interior Acrylic Satin by **Sherwin Williams**.
 - 2. Epoxy over Latex Sealer System

- a. Prime Coat: Primer sealer, latex, interior, **MPI #50**.
 - 1) Basis-of-Design: B28W12600 ProMar 200 Zero VOC Interior Latex Primer by **Sherwin Williams**.
- b. Intermediate Coat: Epoxy, interior high build eggshell (MPI Gloss Level 3), **MPI #144**.
 - a) Basis-of-Design: **Sherwin Williams**.
- c. Topcoat: Epoxy, interior high build eggshell (MPI Gloss Level 3), **MPI #144**.
 - a) Basis-of-Design: **Sherwin Williams**.

B. Semigloss at Steel Substrates (Hollow Metal Doors and Frames):

- 1. Institutional Low-Odor/VOC Latex System **MPI INT 5.1S**:
 - a. Prime Coat: Primer, rust inhibitive, water based **MPI #107**.
 - 1) Basis-of-Design: **Pro Industrial Pro-Cryl Universal Primer B66W01310** by **Sherwin Williams**.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC – Waterbased PreCatalyzed Epoxy, semi-gloss (MPI Gloss Level 5).
 - 1) Basis-of-Design: K46W5151 Pro Industrial PreCatalyzed Waterbased Epoxy - Semi-Gloss by **Sherwin Williams**.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
 - 1) Basis-of-Design: K46W5151 Pro Industrial PreCatalyzed Waterbased Epoxy - Semi-Gloss by **Sherwin Williams**.

C. Flat Sheen at Gypsum Board and Plaster Substrates:

- 1. Latex over Latex Sealer System **MPI INT 9.2A**:
 - a. Prime Coat: Primer sealer, latex, interior, **MPI #50**.
 - 1) Basis-of-Design: B28W12600 ProMar 200 Zero VOC Interior Latex Primer by **Sherwin Williams**.
 - b. Topcoat: Latex, interior, flat (MPI Gloss Level 1), **MPI #53**.

- a) Basis-of-Design: B30W2951 ProMar 200 HP Zero VOC Interior Acrylic Flat or A86W00061 SuperPaint Air Purifying Technology Interior Acrylic Flat by **Sherwin Williams**.

D. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.

- 1. Match system used at surfaces adjacent to insulation covering substrates with primer appropriate for insulation covering.

E. CMU Substrates:

1. High-Performance Architectural Latex System [**MPI INT 4.2D**] [**MPI INT 4.2P**]:

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - 1) Sherwin-Williams: B25W25 PrepRite Block Filler
- b. Prime Coat: Primer, alkali resistant, water based[, **MPI #3**].
 - 1) Sherwin-Williams: LX02W0050 Loxon Concrete & Masonry Primer/Sealer - Interior/Exterior Latex
- c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2)[, **MPI #138**].
 - 1) Sherwin-Williams: B41W2951 ProMar 200 HP Zero VOC Interior Acrylic Low Gloss Eg-Shel

2. Epoxy over Latex Sealer System

- a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4**].
 - 1) Sherwin-Williams: B25W25 PrepRite Block Filler
- b. Prime Coat: Primer sealer, latex, interior, **MPI #50**.
 - 1) Basis-of-Design: B28W12600 ProMar 200 Zero VOC Interior Latex Primer by **Sherwin Williams**.
- c. Intermediate Coat: Epoxy, interior high build eggshell (MPI Gloss Level 3), **MPI #144**.
 - a) Basis-of-Design: **Sherwin Williams**.
- d. Topcoat: Epoxy, interior high build eggshell (MPI Gloss Level 3), **MPI #144**.
 - a) Basis-of-Design: **Sherwin Williams**.

END OF SECTION 09 91 23

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CRMC Switchgear Replacement
Project #CP252301

SECTION 200800 - SEISMIC PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 APPLICABILITY

- A. Seismic supports and restraints shall be provided for all Life Safety and Hazardous or Flammable systems. The following are defined as Life Safety and Hazardous or Flammable:
 - 1. Fire protection equipment and systems.
 - 2. Fire suppression piping.
 - 3. Communication and fire alarm systems.
- B. In addition to the above, seismic supports and restraints shall be provided for all of the following systems:
 - 1. Electrical conduits larger than 2.5-inch.
 - 2. Electrical motor control devices, switchgear, and switchboards.
 - 3. Electrical panelboards.
 - 4. Lighting fixtures.
 - 5. Piping systems.

1.3 EXEMPTIONS

- A. The following mechanical and electrical components are exempt from the requirements of this Section:
 - 1. MEP components that were existing prior to beginning of construction of this project and which are not disturbed during the course of this work, are exempt.
 - 2. Piping and conduit are exempt if the entire run is suspended from 3/8" or 0.5" in diameter rod hangers 12-inches or less in length from the top of the pipe to the supporting structure and the total weight supported by any single rod is 50 lb or less, and if the hangers are sufficient to avoid significant bending of the hangers and their connections.
 - 3. Piping constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 1-inch and smaller, are exempt.
 - 4. Conduit constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 2.5-inch and smaller, are exempt.
- B. There are no further exemptions allowed for Life Safety and Hazardous or Flammable components or systems as defined in the "Applicability" subsection above.
- C. For other than Life Safety and Hazardous or Flammable systems, the following mechanical and electrical components are exempt from the requirements of this Section:

1. If not part of Life Safety and Hazardous or Flammable systems, MEP components weighing less than 20 pounds are exempt if flexible connections are provided between the components and associated ducts, pipes, or conduit.
2. If not part of Life Safety and Hazardous or Flammable systems, MEP components weighing less than 400 pounds are exempt if flexible connections are provided between the components and associated ducts, pipes, or conduit, and if the component is mounted at 48 inches or less above finished floor level.
3. If not part of Life Safety and Hazardous or Flammable systems, piping constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 3-inch and smaller, is exempt.
4. If not part of Life Safety and Hazardous or Flammable systems, conduit constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 2.5-inch and smaller, is exempt.
5. If not part of Life Safety and Hazardous or Flammable systems, electrical conduits, cable trays, and bus ducts are exempt provided that none of the following apply:
 - a. Supports are cantilevered up from the floor.
 - b. Supports are constructed as rigid welded frames.
 - c. Supports include bracing to limit deflection.
 - d. Attachments into concrete utilize nonexpanding inserts, shot pins or cast iron embedments or attachments utilizing spot welds, plug welds, or minimum size welds (as defined in AISC LRFD).
- D. Any otherwise-exempt MEP component, whose failure in an earthquake would potentially damage a non-exempt component, is non-exempt. Example: An exempt storm drain pipe mounted above a non-exempt natural-gas pipe could fall and rupture the gas pipe. Therefore, the storm drain pipe must be treated as non-exempt.

1.4 SUMMARY

- A. Description of Work: The purpose of this section is to define seismic restraint requirements for mechanical and electrical systems, equipment and devices, hereinafter referred to as components.
- B. This Section does not specify seismic force resisting systems for building structures and structural elements.
- C. The requirements for seismic protection specified herein are in addition to any requirements for support and/or seismic protection specified in other sections of these specifications.
- D. The Contractor shall be responsible for developing details to provide proper support of equipment and devices in accordance with the requirements specified herein.
- E. The Contractor shall not proceed with installation of equipment nor seismic protection system until all applicable submittals required by this section have been completed.
- F. This section includes the following:

1. Applicable Code.
2. Project-specific Code Coefficients
3. Rigid Support Items.
4. Non-rigid Support Items.
5. Sway Braces.
6. Anchors, Bolts and Clamps.
7. Restraining Cables.
8. Seismic Snubbers.
9. Installation Requirements.

G. Related sections: The following sections contain requirements that relate to this section:

1. Division 05 Section “Metal Fabrications” for materials to anchor equipment piping to building structure.
2. Division 09 Sections “Interior Painting” and/or “Exterior Painting” for field-applied painting requirements.
3. Division 22 Section “Plumbing Vibration Isolation and Seismic Restraints” for vibration isolation hangers, supports, and flexible connectors.
4. Division 23 Section “Mechanical Vibration Isolation and Seismic Restraints” for vibration isolation hangers, supports, and flexible connectors.
5. Division 23 Section “HVAC Water Systems Piping” for piping and equipment supports.
6. Division 23 Section “Mechanical Insulation” for pipe, duct, and equipment insulation.
7. Division 26 Section “Common Work Results for Electrical” for general electrical requirements.
8. All Division 21 to 26 Sections for mechanical, electrical, and plumbing equipment and systems requiring seismic protection.

1.5 DEFINITIONS

- A. Terminology used in this section is defined in ASCE/SEI 7-16: *Minimum Design Loads for Buildings and Other Structures*, as issued by the American Society of Civil Engineers, 2017; Reston, Virginia.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California.

1.6 PERFORMANCE REQUIREMENTS

- A. This facility is designated as Risk Category IV.
- B. The spectral response acceleration at short periods, S_s , shall be taken as 0.32g.
- C. The spectral response acceleration at one-second period, S_1 , shall be taken as 0.13g.

- D. This facility site is designated as Site Class Definition D.
- E. The Site Coefficients, F_a shall be taken as 1.42 and F_v shall be taken as 2.08.
- F. S_{DS} , the Five-Percent damped design spectral response acceleration at short periods, shall be taken as $S_{DS} = 0.26$.
- G. S_{D1} , the Five-Percent damped design spectral response acceleration at one-second period, shall be taken as $S_{D1} = 0.18$.
- H. This facility is designated as Seismic Design Category D.
- I. The horizontal seismic force on a given component shall be noted as F_p . The seismic force F_p shall be applied at the center of gravity, independently longitudinally and laterally in combination with service loads associated with the component. The following equation shall be utilized individually on every component to determine F_p :
 - 1. $F_p = 0.64 \times I_p \times W_p$ where
 - a. I_p = Component Importance Factor.
 - b. W_p = Component Operating Weight in pounds.
 - 2. In lieu of the above equation, a much more detailed calculation involving Equation 13.3-1 of ASCE 7-16 and its related Tables, which may yield somewhat lower results for F_p , may be utilized. If this option is selected, complete details of all such calculations shall be submitted as required under "Submittals" below.
- J. The vertical seismic force on a given component shall be taken as $0.08 \times W_p$ and shall be determined individually for every component. This vertical force shall be applied at the center of gravity of the component, in either vertical direction, and shall be considered concurrent with the horizontal force determined above.

1.7 SUBMITTALS

- A. The Engineer shall receive one copy of all submittal data supplied to the Owner as required in this specification. It is the responsibility of the Contractor to provide seismic protection as outlined herein. Receipt by the Engineer of a copy of the submittals 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 calculations submitted and equipment proposed.
- B. Prior to installation of equipment and devices requiring seismic restraints, the Contractor shall submit required documentation and details at the shop drawing review stage to the Owner. Submit the following in accordance with conditions of contract and Division 01 specification sections.
- C. Product data: Include installation details and instructions for each type of seismic support and restraint. Submit equipment support and restraint schedule showing size, location, and features for each required support and restraint.

- D. Product certificates: Signed by the manufacturer of seismic supports and restraints certifying that their products meet the specified requirements.
- E. Shop Drawings: Calculations and Drawings signed and sealed by a qualified professional engineer registered to practice in the State of Missouri, shall be provided for the installation details of each piece of equipment. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting seismic restraints. Exception: Certified and stamped calculations are not required for seismic-restrained systems which have been pre-approved by OSHPD or comply with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition; except where more stringent requirements are described herein. A signed letter on Contractor's letterhead shall be provided as part of the submittal process stating which approved systems are being utilized.
 - 2. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - 3. Assembly-type shop drawings: For each type of seismic support and restraint, indicate dimensions, weights, required clearances, and methods of assembly of components. Submittal Drawings shall indicate in complete detail size, type, material grade, locations and dimensions; and shall show construction details, reinforcement, anchorage and installation with relation to the building construction. Submittals shall include, but not be limited to sway braces, flexible couplings or joints, resilient type vibration devices, and anchorage of concrete equipment pads to structure.
 - 4. Where seismic anchors and braces for one component must unavoidably be attached to two or more elements of a structure subject to differential movement, such as a wall and a floor or two different floors, submit sealed calculations for relative displacements; including selection of sufficient flexible fittings to accommodate the relative displacement. Examples subject to relative displacement include vertical pipe or conduit risers; or a pump anchored to a floor and rigidly connected to piping anchored to the roof structure above.
- F. Welder certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- G. Maintenance data: For seismic supports and restraints for inclusion in Operating and Maintenance Manual specified in Division 01, Division 23 Section "Basic Mechanical Requirements" and Division 26 Section "Common Work Results for Electrical."
- H. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. 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.

- I. Contractor's Acknowledgement of Seismic Responsibility: Submit written contractor's statement of responsibility prior to commencement of the work, acknowledging an awareness of the seismic restraint requirements of the project, that control will be exercised to obtain conformance with the Construction Documents, listing procedures for exercising control over the seismic restraint installation, and identifying the responsible person(s) within their organization.

1.8 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "R" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to the weakest mode.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code – Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.9 REFERENCES

- A. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of seismic supports and restraints.
- B. Referenced Codes and Standards: All work provided under this section shall comply with the requirements specified herein, and additionally as provided in the following Codes and Standards. In all cases where conflicting requirements are provided within these specifications, Codes and Standards, the most stringent requirement shall apply.
- C. IBC 2021: Comply with the International Building Code Chapters 16 and 17.
- D. ASCE/SEI 7-16: Comply with *Minimum Design Loads for Buildings and Other Structures*, as issued by the American Society of Civil Engineers, 2017; Reston, Virginia.
- E. NFPA Compliance: Seismic supports and restraints shall comply with NFPA Standard 13 when used as a component of a fire protection system.
- F. UL and FM Compliance: Seismic supports and restraints shall be listed and labeled by UL and FM where used for fire protection piping systems.
- G. ANSI Standards and ASTM Publications: Seismic supports and restraints shall comply with American National Standards Institute, Inc. (ANSI) and the American Society for Testing and Materials (ASTM) Publications.

1. B18.2.1-1981 Square and Hex Bolts and Screws Inch Series
2. B18.2.2-1972 Square and Hex Nuts (R1983)
3. A36-84a Structural Steel
4. A307-86a Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
5. A325-86a High-Strength Bolts for Structural Steel Joints
6. A501-84 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
7. A576-87 Steel Bars, Carbon, Hot-Wrought, Special Quality

- H. ANSI/SMACNA: All seismic restraints for piping and ductwork shall comply with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition. A seismic hazard level (SHL) shall be utilized as scheduled below.

1. All Fire Protection/Suppression Piping: SHL - A
2. All other Piping not listed above: SHL – B

- I. Federal Specification: Seismic supports and restraints shall comply with Federal Specification RR-W-410D for Wire Rope and Strand.

1.10 COORDINATION

1.11 EXTRA MATERIALS

- A. Furnish extra replacement neoprene inserts for all snubbers, which match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. California Dynamics Corp.
 2. Eaton; Cooper, B-Line, and Tolco brands.
 3. Loos & Co., Inc.
 4. Mason Industries, Inc.
 5. Unistrut Corp.; division of Tyco International, Ltd.
 6. Vibration Eliminator Co., Inc.
 7. Vibro-Acoustics, Inc.
 8. The VMC Group; Amber/Booth, Korfund, and VMC brands.
- B. All seismic restraint devices of any one general group; raceways or suspended equipment, or switchgear or other floor mounted equipment, etc., shall be provided by a single manufacturer.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36.
- B. Bolts and Nuts: Square and hex bolts and nuts, ANSI B18.2.1 and B18.2.2, SAE Grade 5, and ASTM A307 or A325.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488. Minimum length of eight times diameter.
- G. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.
- H. Sway Brace: Material used for members listed in Table I of this specification, except for pipes, shall be structural steel conforming with ASTM A36. Steel pipes shall conform to ASTM A501. Note additional exception below.

1. Contractor's Option: In lieu of utilizing angles, rods, bars or pipes as noted in Table I, Uchannel systems consisting of channels, fittings and accessories may be utilized. The uchannel system shall be manufactured as a complete system by one supplier and listed by the manufacturer for use in seismic restraint application. The system shall have the approval of OSHPD. The equipment shall provide multi-directional bracing of electrical conduit, cable tray and mechanical piping/ductwork systems.

TABLE I							
MAXIMUM LENGTH AND ALLOWABLE CONCENTRIC LOADS FOR SWAY BRACES							
Type	Size (inches)			Maximum Length*			Allowable Concentric Load* (kips)
Angles	1½ x 1½ x ¼			4'-10"			3.4
	2 x 2 x ¼			6'-6"	4.6		
	2½ x 2½ x ¼			8'-2"			5.9
	3 x 3 x ¼			9'-10"			7.1
	Rods	¾	3'-1"	2.2	7/8	3'-7"	3.0
Pipes (40S)	1			6'-9"			2.4
	1¼			8'-8"			3.3
	1½			10'-1"			3.9
	2			12'-9"			5.3
	2½			15'-4"			8.4
	3			19'-0"			11.0
*Based on the slenderness ratio of 1/r = 200, and load applied concentrically to brace. The tabulated load values include a 33% stress increase as permitted for seismic loads. For non-concentric loading, allowable brace load is to be determined per the AISC Specification for Structural Steel Buildings / ASD 1989.							

- I. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Reinforcing steel angle clamped to hanger rod is also acceptable.
- J. Restraining Cables: ASTM A603 galvanized steel aircraft cables of minimum diameter 1/8-inch, with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Cables shall conform to Fed. Spec RR-W-410 as follows:
 - 1. Less than 1/8-inch diameter Not Permitted
 - 2. 1/8 to 5/32 inch diameter Type V, Class 1
 - 3. 3/16 inch to 5/16 diameter Type V, Class 2
 - 4. 1/4 inch to 5/8 diameter Type I, Class 2
- K. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- L. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum ¼-inch (6-mm) air gap, and minimum ¼-inch- (6-mm-) thick resilient cushion.
- M. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- N. Flexible Couplings: Flexible couplings shall have same pressure ratings as adjoining pipe.
- O. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.
- P. P. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.
- Q. Galvanizing Repair Paint: High-zinc-dust-content paint, with dry film containing not less than 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation. Examine substrates and conditions under which seismic supports and restraints are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SEISMIC PROTECTION, GENERAL

- A. Attachments and supports for mechanical, electrical, and plumbing systems and components shall be designed to resist the seismic forces specified herein.
- B. Mechanical, electrical, and plumbing systems and components shall be designed by their manufacturer to consider dynamic effects of the equipment and its contents. Design, selection, and installation of seismic bracing for mechanical and electrical systems and components shall account for interaction between equipment and supporting structures, and the effect imposed by attached utility or service lines, and shall ensure that impact between components is avoided during a seismic event.

- C. Anchorage: Install seismic supports and restraints complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
1. Friction resulting from gravity loads shall not be considered to provide resistance to seismic loads.
 2. All bolts, including fasteners and anchor bolts, used for attachment of anchors to components and to structure shall be sized for the seismic forces described in Part I but shall not be less than ½-inch diameter in any case.
 3. Powder-driven fasteners and shot pins shall not be permitted in tension load applications.
 4. Expansion anchors, other than undercut expansion anchors, shall not be permitted to anchor non-vibration isolated equipment rated over 10 horsepower.
 5. Anchorage Embedment Depth: Not less than eight times the anchorage diameter.
 6. Anchorage Edge Distance: Place anchorage not less than ten times the anchorage diameter from edge of concrete housekeeping pad.
- D. Base-Mounted Equipment: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic forces at Project site.
1. Concrete equipment pads shall be anchored to the supporting structure as required to resist the seismic loads specified herein. Anchorage shall adequately distribute loads to the elements of the supporting structure; coordinate with building structural engineer if required. Anchorage devices may consist of either cast-in-place or drilled-in and epoxy grouted reinforcing steel dowels. Unless otherwise indicated, install dowel rods to connect concrete base to concrete floor on 18-inch (450-mm) centers around the full perimeter of the base.
 2. All floor or pad mounted equipment shall be anchored with cast-in-place anchor bolts, expansion bolts or epoxy bolts. For vibratory equipment, the nuts shall be secured against loosening by either installing double nuts, tack welding single nut to bolt or scoring bolt threads.
 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 Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Cast-in-place concrete materials and placement requirements are specified in Division 03.
- E. Resilient Vibration Isolation Devices: Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as for base mounted equipment in subsection above, except that the seismic force found in Part 1 shall be doubled for the purpose of selecting isolation devices, anchorage, and snubbers.
1. Vibration Isolation Devices are suitable for seismic restraint provided the vertical and horizontal seismic forces are within the limits designed into the device.
 2. Resilient and Spring-Type Vibration Devices: Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3. Multi-directional Seismic Snubbers: If vibration isolators are required, then multi-directional seismic snubbers employing elastomeric pads shall be installed on all vibration isolated equipment. These snubbers shall provide 0.25-inches free vertical and horizontal movement from the static deflection point. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Snubber medium shall consist of viscoelastic or other impact-limiting material arranged around a flanged steel trunnion so both horizontal and vertical overturning forces are resisted by the snubber medium.
 4. Install resilient bolt isolation washers on equipment anchor bolts.
 5. Do not short-circuit vibration isolation device with rigid connection directly to structure.
- F. Equipment Sway Bracing: Required for all items supported from overhead structures. Braces shall consist of angles, rods, bars, pipes, cables, or factory fabricated U-channel systems and secured at both ends with not less than ½-inch bolts. Braces shall conform to Table 1, or as recommended by U-channel systems fabricator. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted.
1. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.3 PIPES

- A. General: Select and install restraints for piping and ductwork in complete and strict accordance with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition; except where more stringent requirements are described herein.
- B. Fire protection sprinkler systems shall be seismically braced in accordance with NFPA 13; however, the seismic force calculated per NFPA 13, when multiplied by 1.4, shall not be less than that required by this Specification.
- C. Conduit: Restraints for piping shall also apply to conduit.
- D. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each pipe/duct run, and otherwise at regular intervals spaced no further than required by the above Standard. Walls which ducts penetrate may be considered transverse braces. Sway bracing shall be provided at closer intervals if so recommended by Uchannel manufacturer when using U-channel systems.
- E. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at regular intervals spaced no further than required by the above Standard. Transverse bracing for one pipe/duct section may also act as longitudinal bracing for a pipe/duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and if it is sized for the larger pipe/duct. Sway bracing shall be provided at closer intervals if so recommended by U-channel manufacturer when using U-channel systems.

- F. All equipment installed in line with ductwork, including but not limited to fans, humidifiers, heat exchangers, air terminal units, etc., and which have an operating weight greater than 75 pounds, shall be supported and sway braced independently of the duct system. Appurtenances lighter than 75 pounds, including but not limited to diffusers, dampers, louvers, grilles, etc., shall be positively attached to the ducts with mechanical fasteners.
- G. Anchor Rods, Angles, and Bars: Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as required.
- H. Restraining Cables: Install restraining cables slightly slack. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- I. Hanger Rod Reinforcement: Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe and equipment hangers where required. Do not weld angles to rods.
- J. Clamps: Clamps on uninsulated pipes shall be applied directly to pipes. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp. Vapor barrier shall not be punctured. At trapeze anchor locations, shackle or clamp piping to trapeze.
- K. Vertical Runs: Vertical runs of piping or ductwork shall be braced at each floor and roof level. Provide intermediate lateral braces at 13 foot maximum spacing where story height exceeds 13 feet.
- L. Spreaders: Required between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches (or four times the maximum displacement due to seismic force) apart. Spreaders shall be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe, and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.
- M. Flexible Couplings or Joints: Flexible couplings and joints of the mechanical joint type may be used for aboveground piping. Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3½ inches in diameter.
- N. Mechanical couplings for steel or cast-iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- O. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be galvanized.

3.4 ELECTRICAL EQUIPMENT

- A. Electrical Equipment Bases: Oversized washers and/or reinforcing stiffeners extending to the equipment wall are required at bolted connections through the base, for any equipment bases not designed to transfer seismic loads.
- B. Slide-out components in electrical control panels, computer equipment, etc. shall have a latching mechanism to hold contents in place.
- C. Cutouts in the lower shear panel of electrical cabinets are prohibited, unless one of the following exceptions is met:
 - 1. Factory cutouts made by the manufacturer.
 - 2. Cutouts supported by an analysis demonstrating that remaining cabinet strength is sufficient.
- D. Attachment of additional external items to electrical equipment is prohibited, unless one of the following exceptions is met:
 - 1. Items weighing less than 100 pounds.
 - 2. Items provided by the electrical equipment manufacturer.
 - 3. Items shown by analysis demonstrating their effects are supported by the design.

3.5 CEILING-MOUNTED COMPONENTS

- A. Definition: For the purpose of this section, a ceiling-mounted component includes but is not limited to lighting fixtures. In addition, ceiling components also include speakers, grilles and diffusers, radiant heating panels, fire alarm devices, occupancy detectors and the like.
- B. All ceiling-mounted components weighing 10 pounds (4.5 kg) or less shall have a #12 hanger wire attached to the component and to the structure above. The wire need not be taut. At the housing, loop the wire through an eye on the component housing and wrap a minimum of four times around itself. Install with a minimum of slack so that the wires do not exert significant pressure on the component and no pressure on the ceiling that would cause ceiling distortion.
- C. For ceiling-mounted components weighing more than 10 pounds (4.5 kg) but less than or equal to 56 pounds (25.4 kg), two #12 hanger wires shall be wire attached to the component and to the structure above. The wires need not be taut. At the housing, loop the wire through eyes on the component housing, one at each diagonal corner (for rectangular components) and wrap a minimum of four times around itself. Install with a minimum of slack so that the wires do not exert significant pressure on the component and no pressure on the ceiling that would cause ceiling distortion.
- D. For ceiling-mounted components weighing more than 56 pounds (25.4 kg), the component and any attachments shall be supported directly from the structure.

3.6 ARCHITECTURAL COMPONENTS

- A. Seismic bracing of non-structural architectural components (e.g., exterior curtainwalls, interior partitions, storage racks, veneers, cabinets, signs, appendages and ornamentations, etc.) shall be in accordance with the prescriptive requirements of Article 13.5 of ASCE/SEI 7-16.

3.8 SEISMIC RELATIVE DISPLACEMENT

- A. Do not attach seismic anchorage or bracing for any one component to two or more elements of a structure subject to differential movement, such as a wall and a floor or two different floors. Do not attach seismic anchorage or bracing for any one component to two or more separate structures or structural systems.
- B. Piping, conduit, ductwork, cable tray, etc. shall be designed to accommodate differential movement between components and structures when attached to structures that could displace relative to each other and where the components cross a seismic isolation interface. Examples include vertical pipe or conduit risers; or a pump anchored to a floor and rigidly connected to piping anchored to the roof structure above. Furnish and install sufficient flexible fittings to accommodate the relative displacement.

3.9 ADJUSTING

- A. Adjustment: Adjust supports and restraints to distribute loads equally on attachments. Adjust snubbers according to manufacturer's written recommendations. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- B. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.10 CLEANING

- A. After completing equipment installation, inspect seismic-control devices. Remove paint splatters and other spots, dirt, and debris.
- B. Paint Touch-Up: Immediately after installation of equipment, devices and seismic protection system; clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas per requirements in Division 09 painting sections.
- C. Galvanizing Touch-Up: Immediately after installation of equipment, devices and seismic protection system; clean field welds, bolted connections, and abraded areas of galvanizing. Apply galvanizing repair paint to comply with ASTM A780.

3.11 FIELD QUALITY CONTROL

- A. Review: The Owner will engage an independent special inspection agent to review seismic restraint submittals and to perform the following field quality control review:

1. Examine all mechanical and electrical systems and equipment to confirm all seismic restraint systems are installed properly and in compliance with these specifications and the submittals.
 2. Examine all seismic restraints and seismic snubbers for minimum clearances.
 3. Examine all cable bracing systems for proper installation, angle of slope, and tension or slack.
- B. Report: The Owner's special inspection agent shall submit a certification report(s) to the Owner's Representative for seismic special inspections to verify the above review and to include the following:
1. Certify that all seismic-restraint systems are installed properly and in compliance with these specifications and the submittals.
 2. Identify those areas that require corrective measures or certify that no corrective measures are necessary.
 3. Any changes to the originally submitted seismic restraint designs, such as those due to field coordination, shall be clearly defined and detailed in the report.

END OF SECTION 20 0800

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DIVISION 21 – FIRE PROTECTION

210000	Fire Protection General Conditions
210010	Basic Fire Protection Materials and Methods
210020	Seismic Controls for Fire Protection and Equipment
210500	Fire Protection

SECTION 210000 - FIRE PROTECTION GENERAL CONDITIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 210000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The fire protection work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "FP Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- E. It shall be a part of this FP Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

International Building Code (IBC) - 2024 Edition

International Fire Code (IFC) - 2024 Edition

Underwriters Laboratories (UL), "Fire Protection Equipment Directory", Latest Edition

Factory Mutual Systems (FM), "Approval Guide", Latest Edition

NFPA 13 - Installation of Sprinkler Systems - 2022 Edition

NFPA 14 - Installation of Standpipes, Private Hydrants and Hose Systems - 2022 Edition

Local Code Amendments

Requirements of the Authority Having Jurisdiction

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. FP Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this FP Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this FP Contractor. Ductwork, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all duct, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as curbs and sealing, etc., which are not shown on the plan view. This FP Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This FP Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders

of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.

- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This FP Contractor, before submitting his bid, shall visit the site and thoroughly acquaint himself with conditions under which the work will be performed.
- B. Failure to fully acquaint himself with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract. See General Conditions for additional requirements.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations. See General Conditions for Advance Operation of Elevators.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General, Special Conditions, and NFPA 13. FP Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The FP Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to

SSC Engineering, Inc.

Attention: Submittals
1820 Edison Ave.
Chesterfield, MO 63005

4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The FP Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the FP Contractor marked accordingly.
- E. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- F. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- G. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this FP Contractor.
- H. Shop drawings shall include the plan mark used on the plans.
- I. Shop drawings and product data for equipment shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- J. Submittals which do not provide the required information will be returned unchecked.
- K. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- L. This FP Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- M. The FP Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the FP Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction

Change Directive has been issued authorizing the deviation. The FP Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.9 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed by this FP Contractor. The installing FP Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- D. Contractor shall also submit one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Complete set of shop drawings.
 - 2. Copies of all submittals.
 - 3. Parts lists, wiring diagrams, piping diagrams, etc.
 - 4. Manufacturers' operating and maintenance instructions.
 - 5. As-built drawings.
 - 6. Written operating and maintenance instructions for the system.
 - 7. Copies of warranties.
 - 8. Parts list for each piece of equipment and name of local supplier.
- E. At a predetermined time, prior to the facility opening, an instructional session shall take place. The installing contractors and major suppliers shall instruct the Owner's operating personnel on operation and maintenance of the systems. The installing FP Contractor shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.10 RELEASE OF CAD FILES

- A. See "Release of Cad Files" at the end of this section.

1.11 RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the FP Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of piping, ductwork and other concealed facilities are to be shown by the FP Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the FP Contractor in CAD format, FP Contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 WORKMANSHIP AND MATERIALS

- A. All work shall be performed in a manner acceptable to the Engineer, Architect, and the Owner, by properly trained, supervised and experienced personnel using new and clean materials, supplies, equipment, and hardware.

1.13 MATERIAL AND EQUIPMENT HANDLING AND STORAGE

- A. It is recognized that space at the project for storage of materials and products is limited. Coordinate the deliveries of electrical materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment to the project substantially ahead of the time of installation.

1.14 GUARANTEE AND WARRANTY

- A. This FP Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year in accordance with the General Conditions.
- B. During the guarantee period, this FP Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required during this period at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this FP Contractor's bid. This FP Contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall furnish all material, equipment, labor, services, supplies, etc., required to execute to completion all work shown on the mechanical, electrical, fire protection, and plumbing drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. This FP Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This FP Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, this FP Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If this FP Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, this FP Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.

- C. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- D. The Electrical Contractor shall furnish and install all interlock wiring unless specifically noted otherwise.
- E. Contractor furnishing electrically-operated equipment (e.g. alarm bells or AV devices) shall furnish electrical characteristics to the Electrical Contractor so that the devices are properly installed.
- F. Unless specifically noted otherwise, pilot controllers (flow switches, tamper switches, pressure switches, etc.) shall be furnished and mounted by the FP Contractor furnishing the controlled equipment.
- G. Electrical Work For Fire Protection Equipment: Electrical Contractor shall wire all fire protection equipment furnished by various contractors in accordance with the following general provisions:
 - 1. Power and control wiring for flow switches, tamper switches, pressure switches, electric bells and audio visual devices.
- H. Fire Protection Contractors shall provide the following:
 - 1. Automatic control and interlock wiring diagrams as called for in the specifications.
 - 2. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical wiring.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This FP Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this FP Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This FP Contractor shall cooperate with and coordinate with the Owner's Representative to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.

- C. All interruptions shall be scheduled, and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.
- D. Pipes which are shown to be installed or demolished in subsequent phases that are needed for earlier phases to make the earlier phase operational shall be installed or demolished in the earlier phase during non-business hours. Where later phase work is performed in an earlier phase, contractor shall remove and replace ceilings as required to perform the work.

3.5 DEMOLITION OF FACILITIES

A. General

1. The demolition work shall consist of removal of piping pertaining to the installation and modifications of the sprinkler system as indicated on the drawings.
2. Contractor shall note the project is a renovation to an existing building. The building shall remain in operation at all times during the construction. FP Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.
3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The FP Contractor shall be responsible to field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
4. This FP Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the mechanical and plumbing drawings.
5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
7. All mechanical equipment to be reused shall be disconnected, marked and protected where necessary.

B. Existing Conditions

1. Contractor shall exercise great caution when performing demolition work so as not to damage existing systems or items of work that are to remain. If the FP Contractor damages, removes or destroys an existing system which is to remain, the FP Contractor shall repair or replace that system to its original condition.
2. Unless specifically stated otherwise on the plans, where access to a sprinkler system item is required, it shall be the responsibility of this FP Contractor to provide the required access by removing ceiling, cutting openings, etc., as required. Prior to cutting openings, this FP Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the Owner's Representative.

Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.

3. Areas shall be repaired with materials matching those which have been removed.
4. It shall be a part of this FP Contractor's work to repair streets, sidewalks, parking lots and to reseed grassed areas which have been altered by the work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This FP Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. The work shall proceed in a manner to minimize any spread of dust, debris and flying particles, and so that any related effects of demolition do not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, this FP Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Disposition of Material

1. Those items of material and equipment to be removed by this FP Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this FP Contractor and shall be removed from the job site and legally disposed of.

3.6 RELOCATION OF EXISTING EQUIPMENT

- A. Some items of existing equipment are to be relocated as indicated on the drawings. All utility connections in the existing location shall be disconnected by this FP Contractor. This FP Contractor shall reconnect the utility in the new location. These utilities include electric and piping. The equipment shall be moved from the existing location to the new location as indicated on the drawings.
- B. Unless otherwise indicated, equipment shall be relocated in the condition in which it exists before relocation begins. This FP Contractor is not responsible for reconditioning existing equipment unless otherwise indicated. Prior to disconnecting any utilities and prior to placing the equipment out of service, this FP Contractor shall, in the presence of the Owner's Representative, inspect all items or equipment scheduled for relocation and shall document deficiencies which might affect this FP Contractor. After the equipment is in place in its new location, it shall be the responsibility of this FP Contractor to reconnect the utilities and place the equipment into proper operation.
- C. This FP Contractor shall be responsible for damage done to the equipment during relocation. Except for the documented deficiencies, all deficiencies shall be considered to have occurred

during relocation, in which case this FP Contractor shall repair or replace at no additional cost to the Owner.

3.7 MAINTENANCE OF WORK AREAS

- A. During the project, this FP Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

- A. Upon completion of this work, the FP Contractor shall clean all pipes and equipment. FP Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. Each FP Contractor shall be responsible for his own cleanup to a central location designated by the Owner. FP Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work as directed by the Owner.

END OF SECTION 210000

RELEASE OF CAD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2018. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CAD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

_____ Company	_____ Version of AutoCAD used
_____ Name (Must be an officer of the Company)	_____ E-mail address
_____ Title	_____ Maximum e-mail attachment size
_____ Date	

SECTION 210010 – BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 210000 - Fire Protection Conditions.
- C. This section covers basic fire protection materials and methods for Fire Protection work and applies to work of those sections.

PART 2 - PRODUCTS

2.1 PRODUCT CRITERIA

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All piping, valves, sprinklers, and equipment shall be manufactured in the U.S.A.
- C. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare

PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- D. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

E. Abbreviations

1. AC	Air Conditioning Unit	33. FHV	Fire Hose Valve
2. ADJ	Adjustable	34. FHC	Fire Hose Cabinet
3. AF	Anti-Freeze	35. FIN	Finish
4. AFF	Above Finished Floor	36. FLR	Floor
5. AHU	Air Handling Unit	37. FM	Factory Mutual
6. AP	Access Panel	38. FPC	Fire Protection Contractor
7. BFP	Back Flow Preventor	39. FPM	Feet per Minute
8. BHP	Brake Horsepower	40. FT	Feet
9. BTU	British Thermal Units	41. FS	Flow Switch
10. BOD	Bottom of Duct	42. FURN	Furnished
11. BOP	Bottom of Pipe	43. FS	Flow Switch
12. BOS	Bottom of Steel	44. GAL	Gallons
13. CAP	Capacity	45. GALV	Galvanized
14. CONN	Connected	46. GC	General Contractor
15. CV	Control Valve	47. HR	Hour
16. CC	Center to Center	48. HP	Horsepower
17. CFM	Cubic Feet per Minute	49. IE	Invert Elevation
18. CI	Cast Iron	50. IN	Inches
19. CL	Center Line	51. INST	Installed
20. CLG	Ceiling	52. KF	K-Factor
21. CPVC	Chlorinated Polyvinyl Chloride	53. KW	Kilowatt
22. D	Drain	54. LRA	Locked Rotor Amps
23. DIA	Diameter	55. MAX	Maximum
24. DISC	Disconnect	56. MC	Mechanical Contractor
25. DN	Down	57. MIN	Minimum
26. EJ	Expansion Joint	58. NO	Normally Open
27. EC	Electrical Contractor	59. NC	Normally Closed
28. EFF	Efficiency	60. NO.	Number
29. EX	Existing	61. NTS	Not to Scale
30. FCU	Fan Coil Unit	62. PC	Plumbing Contractor
31. FDC	Fire Department Connection	63. POC	Point of Connection
32. FH	Floor Hydrant	64. RND	Round
		65. SW	Switch
		66. STL	Steel

67.	SG	Sight Glass	74.	TS	Tamper Switch
68.	SP	Static Pressure	75.	UH	Unit Heater
69.	SPC	Sprinkler Contractor	76.	VAV	Variable Air Volume Box
70.	SQ	Square	77.	VFD	Variable Frequency Drive
71.	SQ FT	Square Foot	78.	VTR	Vent Thru Roof
72.	SS	Stand Pipe System	79.	WC	Water Column
73.	TOP	Top of Pipe	80.	WS	Water Flow Switch

2.3 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.4 SLEEVES

- A. Exterior And Foundation Walls: All piping through exterior or foundation walls shall pass through schedule 40 galvanized steel sleeves which shall be large enough to allow for caulking material. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved by the Engineer.
- B. Interior Walls and Partitions: All piping through interior walls and partitions that are fire rated shall pass through either schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves. Schedule 40 steel pipe sleeves must be used when required for structural purposes.
- C. Floors: All piping through floors shall be provided with schedule 40 carbon steel pipe sleeves, extending 2 inches above floor except in finished areas. Sleeves in finished areas shall terminate flush with floor, and shall be schedule 40 carbon steel pipe.

2.5 BACKING AND SEALANTS

- A. Backing and sealant for piping and ducts passing through floors, plaster ceilings, partition, and walls shall be as follows:
 - 1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
 - 2. Sealant: Gun Grade. An 1-part modified polyurethane, gun applied, elastic sealant, "Dymonic" by Tremco, or Chem-Calk 900 by Bostik.
 - 3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to

provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following: 1) "SpecSeal" by Specified Technologies Inc. 2) 3M, 3) Chase Technology Corporation, 4) Link-Seal, 5) Pyro-Pac by Thunderline Corporation, 6) "Fyre Seal" by Tremco, 7) Pensil 100 by General Electric, 8) Pensil by STI, or 9) "Flameseal" by G. S. Nelson Electric.
 - a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
 - b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
 - c. Fire stop putty. "Flameseal" by G. S. Nelson Electric.
 - d. Intumescence Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to >1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.
 - e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.
 - f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.
 - g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
 - h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.

- i. Pillows (SpecSeal Firestop Pillows) shall be an intumescent pillow heat sealed in a fire-retardant poly bag with a monolithic core encapsulated by flexible intumescent coating and shall expand when exposed to 230°F to >1000°F.
- j. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≤ 52 lb./cu.ft., dry mortar density shall be ≤ 45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.
- k. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.
- l. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.
- m. Intumescent Wrap Strips
 - 1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.
 - 2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.
- n. Intumescent coatings (SpecSeal Cable Coating) shall be water based, intumescent coating, expand a minimum of 5 times its dry applied thickness, flexible, water and weather-resistant film, contain no solvents or inorganic fibers. Coating shall be thixotropic and be capable of being applied by brush application or by airless spray.
- o. Urethane Joint Sealants
 - 1) Subject to compliance with requirements, provide one of the following:
 - a) Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
 - b) Polymeric Systems, Inc.; PSI-901.
 - c) Approved equal.
 - 2) Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS for vertical surfaces or Grade P for horizontal, Class 50, for Use "NT" for Non-Traffic.

2.6 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.7 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, boxes, panels, etc., shall be furnished and installed by the Contractor requiring the opening.
- B. Lintels furnished shall be structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.8 CUTTING

- A. All openings for conduit, pipes, etc., shall be provided by each Contractor by means of sleeves or framed openings.
- B. Each Contractor shall be responsible for any cutting required for conduits, pipes, etc., if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- C. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., each contractor shall obtain the Owner's approval in advance of the cutting and patching.

2.9 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Painting Contractor.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Painting Contractor.
- C. Surfaces with finishing materials - Such as tiled, paneled, stone or marble surfaces, patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching and shall be subcontracted to the Owner's Interior Furnishing Contractor doing the specific finish work.

2.10 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be Allen Systems, Inc., W.H. Brady Co. - Signmark Div., or Industrial Safety Supply Co., Inc.

- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high letters. Provide 5/32" hole for fastener. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for proper attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name and plan number, 2) Equipment service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.11 CEMENT GROUT

- A. Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.12 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall furnish and install all bases, anchor bolts, and structural steel to support the equipment, piping, etc., furnished and installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Concrete housekeeping pads to be provided by Division 3. Concrete housekeeping pads shall be a minimum of 3-1/2" high, unless detailed otherwise, under all equipment, pumps, etc., in the equipment rooms where piping containing water is located. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be 1/2" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment. Plywood shall be fire resistant treated in Type I and Type II Buildings.

3.2 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. This Contractor shall ascertain from his examination of the architectural and structural drawings whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary. The Contractor shall pay all cost of making such openings or providing such supports.

3.3 CUTTING AND PATCHING

- A. All cutting that may be necessary for the installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut. No openings shall be cut without written approval of the Owner's Representative.
- B. Repair of Spray Fire Proofing Materials
 - 1. Where fireproofing materials are damaged during the installation of the fire protection system, fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied or patching materials recommended by the manufacturer. Repaired areas shall be retested and re-inspected. Fireproofing material shall be applied by hand-trowel, or by respraying. Coordinate with General Contractor and Spray Fire Proofing contractor.

3.4 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.

- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.5 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor requiring access shall provide access panels.
- C. Contractor shall not provide access panel to equipment above drywall ceilings in sales areas or restrooms without written permission of Architect/Engineer.

3.6 PAINTING

- A. All pieces of mechanical equipment shall be factory finished machinery-grey or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.
- B. This Contractor shall paint the following items:
 - 1. Items specified under "Demolition and restoration of facilities", Section 210000 shall be painted.
 - 2. No other painting is required unless specifically called for on the plans.
 - 3. Coordinate with Architect for painting of exposed piping.

3.7 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves through outside walls shall be cut smooth and shall be flush with each side of the wall.
- C. Sleeves through floors shall extend 2" above finished floors.
- D. Sleeves in foundation walls or footings shall be as detailed on the plans. No sleeves, other than those shown on the drawings, shall be installed through footings or foundations without obtaining approval from the Structural Engineer.
- E. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. Sleeves shall be grouted in place.
- F. Where pipes pass through existing foundation walls or concrete walls below grade, the hole shall be core drilled.

- G. Where pipes pass through firewalls composed of plaster or drywall, fire sealant shall be applied around the outside of the sleeve to seal between sleeve and wall per UL requirements.
- H. The internal diameter of sleeves shall be 1" larger in diameter than the outside diameter of the pipe or pipe insulation. Insulation shall be continuous through sleeve.
- I. The space between the pipe and the sleeve shall be sealed with fire resistant silicon foam sealant, CTC PR-855 by Chase Technology Corporation, or equal. Link-Seal, Pyro-Pac by Thunderline Corporation is acceptable in lieu of the silicon foam sealant listed above. "Flameseal" fire stop putty by G. S. Nelson Electric is also acceptable. Products used shall be U.L. Classified, shall produce non-toxic fumes, and shall be asbestos free.
- J. Where pipes pass through concrete walls below grade, the space between the pipe and the core drilled hole or sleeve shall be completely filled. Caulk outside with lead wool packed watertight. Caulk outside surface between pipe and sleeve or hole with General Electric, or equal, silicon caulking. Link-Seal as described above is acceptable in lieu of lead wool.
- K. Chrome plated escutcheons shall be provided at all locations where pipes penetrate walls in exposed locations.
- L. Interior Non-Rated Walls/Partitions:
 - 1. Concealed locations: Limit the size of the space between the wall and the outside of the pipe to 1" maximum. The space between the pipe and the wall may be left open.
 - 2. Visible Locations: Openings between pipes and wall shall be covered with chrome plated escutcheons.
- M. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - 1. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.), the pipes shall be sealed per approved methods to meet U.L. Classifications.

3.8 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 - 1. Adjacent to each valve.
 - 2. At each branch or riser take-off.
 - 3. Where piping goes through floors, walls or ceilings.
 - 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
- B. All color coding shall comply with ANSI A13.1 1975.
- C. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.

- D. Provide valve tag on every valve and control device in each piping system; exclude check valves and valves within factory-fabricated equipment units. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.
- E. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and plan number and) B Equipment service, matching terminology on schedules as closely as possible.

END OF SECTION 210010

SECTION 210020 – SEISMIC CONTROLS FOR FIRE PROTECTION PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide seismic restraints as indicated for each type of equipment and for piping systems. This section applies to Fire Protection Systems.
- B. Scope of work
 - 1. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
 - 2. Seismic control manufacturer shall have the following responsibilities:
 - a. Determine seismic restraint sizes and locations.
 - b. Provide piping and equipment seismic restraints as scheduled or specified.
 - c. Provide installation instructions and drawings.
 - d. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, and project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
 - 3. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 4. All piping shall to be restrained per NFPA 13. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

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.
- B. Section 210000 - Fire Protection General Conditions.
- C. Section 210010 - Basic Fire Protection Material and Methods.
- D. Section 210500 – Fire Protection.

1.3 REFERENCES

- A. NFPA 13 (Reference Specification Section 210000 for Edition)

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Restraint Loading:

1. Site Class as Defined in the IBC: D
2. Assigned Occupancy Category or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: See Schedule on drawings.
 - b. Component Response Modification Factor: See Schedule on drawings.
 - c. Component Amplification Factor: See Schedule on drawings.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 21.3%.
4. Design Spectral Response Acceleration at 1-Second Period: 16.7%.
5. Seismic Design Category: D.
6. See also: Structural Drawings.

1.6 SUBMITTALS

- A. Product Data: For the following:
 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, and seismic restraints.
 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Seismic Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- C. Coordination Drawings: Show coordination of seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD or an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- C. Specification SC: Restraint Cables:

1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cables and Type SRC Seismic Rod Clamps.
 2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 wide, in varying lengths and combinations to meet load capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.
- E. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.
- F. Specification SAB: Seismic Anchor Bolts
1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
 2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use except as otherwise indicated.

3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic/wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 210010 for installation of equipment supports.
- B. Equipment Restraints:
 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 2. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- C. Piping Restraints:
 1. Comply with requirements in MSS SP-127 and NFPA 13.
 2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
 3. Brace a change of direction as indicated on the drawings or the local building code.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all

directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 per cent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.

- F. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure:
 - 1. Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
 - 2. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic restraint vendor's calculations.
 - 3. Capacity for concrete inserts used for support attachment shall not exceed the combination of gravity and seismic loads on the support.
- J. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211014 "Wet Standpipe and Sprinkler Systems Renovation" for piping flexible connections.

3.5 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 FIRE PROTECTION VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. See schedule on plans.

END OF SECTION 210020

SECTION 210500 – FIRE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all labor, services, material and related items necessary to complete the fire protection work indicated on the drawings and/or specified herein. Sprinkler locations are shown on the drawings; contractor shall design the piping to feed the sprinklers and perform hydraulic calculations of the system in accordance with NPFA 13. Sprinkler systems shall comply with performance requirements and design criteria; include analysis data signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.
- B. The contractor shall include in this contract, at no additional cost, any sprinklers not shown on the drawings, but required by NFPA 13 or the local authority having jurisdiction.
- C. Provide a working installation complete in every detail with all items necessary for such an installation whether or not specifically mentioned herein or shown on the drawings.
- D. Provide all labor, services, material and related items necessary to complete the fire protection work indicated on the drawings and/or specified herein, in accordance with NPFA 13.
- E. Work to be performed shall include, but not be limited to the following fire protection systems:
 - 1. Wet-pipe sprinkler system

1.2 RELATED SECTIONS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 210000 - Fire Protection General Conditions
- C. Section 210010 - Basic Fire Protection Material and Methods
- D. Section 210020 - Seismic Controls For Fire Protection Piping and Equipment
- E. Division 26 – Electrical

1.3 REFERENCES

- A. All work shall be designed and installed in accordance with all applicable codes and referenced design standards. Refer to Section 210000 Fire Protection General Conditions for applicable codes and standards.

1.4 QUALITY ASSURANCE

- A. All materials and equipment under this section of the specifications shall be approved by Factory Mutual and Underwriter's Laboratories for fire protection systems installation.

1.5 REGULATORY REQUIREMENTS

- A. All work shall be installed in accordance with the currently enforced edition of the National Fire Protection Association 13 and shall meet the requirements of the Owner, the local Fire Marshal and the municipal Department of Building Regulations.
- B. The system shall not be accepted until final testing and receipt of the Contractor's Material and Test Certificate, Part "A" General.

1.6 SUBMITTALS

- A. The fire protection drawings have been prepared using Autocad. The fire protection plan drawing files will be made available to the successful automatic sprinkler contractor either in the form of a diskette or by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed; see Section 210000. Utilization of these documents for the development of shop drawings and submittals does not relieve the sprinkler contractor from any of his responsibilities herein. By accepting these drawing files, the sprinkler contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files.
- B. Complete shop drawings shall be submitted for their approval as follows:
 - 1. Through the General Contractor to the Engineer
 - a. Quantities of shop drawings shall be as indicated in Section 210000. Submittal must be comprehensive of the entire project, complete in all details and at the same scale as the Architectural plans. Submit shop drawings and hydraulic calculations that have been sealed by the qualified professional engineer responsible for their preparation. Hydraulic calculations shall include velocity, end pressure and flow at each sprinkler in the remote areas, in addition to other NFPA 13 criteria.
 - b. Manufacturer's literature on all system equipment, pipe and fittings. Literature shall clearly identify exactly what components are being provided including finish, size, type and options.
- C. Shop drawings shall also be submitted to all local authorities and the Owner's insurance carrier prior to fabrication and the start of work.
- D. Certificate of Installation: Submit certificate upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13, NFPA 24, and also that system is operational, complete, and has no defects.
- E. Operation and Maintenance Data: Submit operation and maintenance data and parts lists for fire protection material and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation, and record drawings in Maintenance Manual in accordance with requirements of Division 1.
- F. Shop Drawings: Shall include plans, pipe elevations, riser sections, stairway/standpipe sections, details, and attachments to the structure, prepared according to NFPA 13. Include a hydraulic

summary for each remote area and clearly labeled hydraulic nodes corresponding to the hydraulic calculations. Shop Drawings shall be signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.

- G. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping, sanitary piping, and storm piping.
 - 2. HVAC ductwork and hydronic piping.
 - 3. Electrical conduits over 2" diameter.
 - 4. Structural steel.
- H. Submit product data for all equipment, piping, sprinklers, hangers, structural attachment devices, etc. Product data submittals shall indicate the specific model number of products to be provided. Finish colors of sprinklers and exterior equipment shall be indicated. Items that are shown on combined data sheets that will not be provided shall be marked to indicate they are excluded from the product submittal.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, type, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide size and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection piping systems. Where more than one type of material or products are indicated, selection is Installer's option.

2.2 IDENTIFICATION

- A. Install fire protection signs on piping in accordance with NFPA 13 and NFPA 14 requirements.

2.3 MATERIALS

- A. All material and equipment furnished shall be listed by Underwriter's Laboratories, Inc. as approved for the fire protection services and installed in accordance with the recommendations of the specific manufacturer.
- B. All materials used outside of the building envelope shall be designed for exterior use in a wet environment and shall be protected via material composition or coatings from corrosion / rusting.

2.4 DESIGN

- A. Refer to the Fire Protection Coversheet for densities which have been established by NFPA 13 and shall be used by the Sprinkler Contractor in the design and hydraulic calculations.
- B. Refer to Fire Protection Coversheet for flow test information and requirements.

- C. The information given herein and on the plans is as exact as could be secured for bidding purposes, but its accuracy is not guaranteed. This Subcontractor must examine the job conditions and verify all measurements, distances, elevations, clearances, pipe sizes, etc. before starting his work.
- D. The Contractor shall provide all necessary offsets, raises or drops in piping and auxiliary drains required by building conditions whether or not shown on the plans.
- E. Piping is to be held as high as possible and maintain natural drainage back to the main system risers whenever possible.

2.5 HYDRAULIC CALCULATIONS

- A. Hydraulic calculations shall be prepared on form sheets that include a summary sheet, a graph sheet, a water supply analysis, a node analysis, and detailed worksheet per NFPA 13.
- B. Hydraulic calculations shall be signed and sealed by the qualified professional engineer, licensed in the jurisdiction of the project, and responsible for their preparation.
- C. Contractor shall verify safety factor requirements with the local Authority Having Jurisdiction.
- D. Hazard classifications for fire protection system design, installation and water supplies shall be in accordance with NFPA Standards. Shop drawings shall indicate the Hazard Classification for each area.

2.6 COORDINATION AND PIPE SIZING

- A. Pipe sizes and routing, and exact sprinkler location shall be based on hydraulic calculation and spacing requirements. This Contractor shall be responsible for total coordination of the reflected ceiling plan using the engineered HVAC, electrical and architectural plans.

2.7 OVERHEAD PIPE AND FITTINGS

- A. Black Steel Pipe
 - 1. Feed mains and standpipes 2-1/2" and larger shall be Schedule 40 black steel pipe designed to withstand a working pressure of not less than 175 P.S.I.
 - 2. Cross mains and branch lines 2" and smaller shall be Schedule 40 black steel pipe designed to withstand a working pressure of not less than 175 P.S.I.
 - 3. Fittings shall be 175 P.S.I. threaded or flanged black cast iron or approved equivalent such as mechanical groove or welded construction. Plain end fittings such as "Vic Fitt" shall not be allowed.
 - 4. Piping is to be held as high as possible where exposed.
 - 5. Wet system pipe may be installed level as per NFPA 13.

2.8 FLEXIBLE CONNECTOR ASSEMBLY

- A. Designed for installation above suspended ceilings and consisting of a flexible metallic hose assembly with an inlet nipple and a straight or 90 degree bend type reducing fitting plus a

support bracket to position and secure the sprinkler end to ceiling support tees. The galvanized steel bracket shall accurately locate the sprinkler in the center of the ceiling grid. Flexible hose shall have a corrugated, type 304 stainless-steel inner tubing covered with stainless-steel wire braid with steel nipples welded to hose. 175-psig minimum working-pressure rating. Threaded ends; 1" inlet and ½" or 3/4" outlet (sprinkler end).

B. Manufacturers:

1. FlexHead Industries.
2. EasyFlex.
3. SprinklFlex.
4. Victaulic VicFlex.
5. Approved Equivalent.

2.9 HANGERS AND SLEEVES

- A. All hangers to be of approved materials and spaced in accordance with NFPA 13. The section modulus required by NFPA 13 shall be provided for all trapeze members supporting piping.
- B. Sleeves shall be set for all pipes passing through concrete floors, foundations and masonry walls.
- C. Provide escutcheon plates at all wall penetrations.
- D. See Section 210010, BASIC MATERIALS AND METHODS, for requirements for sleeves in both new and existing construction.
- E. Piping and support systems shall be seismically braced in accordance with Section 210020 and NFPA 13 and its appendices.
- F. Horizontal pipe supports shall be spaced as specified NFPA 13 and a supports shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads in excess of 50 pounds, suspended from steel joists, shall have the hanger loads suspended from panel points. Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
- G. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers.

2.10 TEST AND DRAIN CONNECTIONS

- A. Provide combination inspector's test/main drain valve with pressure relief, 2" diameter with a 1/2" test orifice.
- B. Auxiliary drains consisting of plugs, or globe valves and plugs where capacity of trapped pipe section exceeds five gallons, shall be provided to drain all points in the system that cannot be drained back to a main riser as shown on the plans.

1. A label shall be provided below ceiling indicating location of auxiliary drain.

2.11 INSPECTOR'S TEST CONNECTION

- A. Provide inspector's test connections for the system as required. UL Listed, bronze body, with chrome plated bronze ball, brass stem, steel handle, Teflon seat and site glasses. Connect to drain riser and route to standpipe in sprinkler room.

2.12 EXTERIOR VALVES - None.

2.13 INTERIOR VALVES

- A. Gate valves shall be 175 P.S.I. working pressure, approved indicating type, rising stem, O.S. & Y valve. Acceptable manufacturers: Milwaukee, Mueller, Nibco, Stockham, Viking or approved equal.
- B. Butterfly valves shall be 175 P.S.I. working pressure, approved indicating valve. Acceptable manufacturers: Victaulic, Nibco, Gruvlok, Tyco, Viking or approved equal.
- C. Check valves shall be 175 P.S.I. working pressure horizontal swing or wafer check valves. Acceptable manufacturers: Mueller, Nibco, Stockham, Tyco, Gruvlok, Victaulic, Viking or approved equal.
- D. Globe valves shall be 175 P.S.I. working pressure, bronze threaded globe valves with renewable composition disc. Acceptable manufacturers: Crane, Milwaukee, Nibco, Stockham or approved equal.
- E. Hose valves on the standpipes shall be equal to Potter Roemer Model #4065, UL listed, 175 lb., 2-1/2" hose valves, polished brass, complete with cap and chain.

2.14 SUPERVISORY SWITCHES

- A. All valves on the sprinkler system shall be supervised. Valve switches to be furnished and installed by the Sprinkler Contractor and wired by the Electrical Contractor to the fire alarm control panel. Valve supervisory switches shall be Potter, Guardian, System Sensor or approved equal.

2.15 SPRINKLERS

- A. Acceptable sprinkler manufacturers: Tyco, Globe, Reliable, Victaulic, and Viking. Only sprinklers manufactured after January 1, 2004, shall be acceptable. Sprinkler manufacturer preferred to match existing sprinklers in building.
- B. Furnish and install sprinklers as shown in "Sprinkler Schedule" on Fire Protection Coversheet.
- C. Sprinkler guards are to be provided on all sprinklers located less than 7'-0" from finished floor and where subject to mechanical injury.

- D. High temperature sprinklers of proper degree rating shall be installed in boiler room, storage areas or where necessary.
- E. All sprinklers shall be provided with the appropriate temperature and response rating based on location and occupancy. Contractor shall verify the location and temperature of all heat producing equipment.
- F. Extended coverage sprinklers shall be provided only where the water supply is sufficient to supply the listed pressure. Where the water supply is not sufficient, standard coverage sprinklers shall be provided.
- G. Provide two (2) extra sprinklers of each type used in this scope and store at the existing sprinkler cabinet.

2.16 ELECTRIC ALARM: Electrically operated audio/visual horn and strobe device.

2.17 PIPE ALIGNMENT GUIDES

- A. Alignment guides shall be factory fabricated with split steel guiding cylinder with anchor case and split steel spider. Guiding cylinders shall be split at 45 degrees and shall be designed to accommodate specified insulation thickness. Allow 1/8" minimum clearance between I.D. of guiding cylinder and O.D. of insulation.
- B. Guides shall be equal to ADSCO Model E for steel piping. Equal guides by MetraFlex are acceptable.

2.18 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0 to 250 psig minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 FLOW TEST

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations.
- B. Report test results with hydraulic calculations.

3.2 INSTALLATION OF FIRE PROTECTION SYSTEMS

- A. All items necessary for a working installation complete in every detail shall be furnished and installed whether specifically mentioned or not.
- B. Pipe sizes shown on drawings are minimum required pipe sizes only. Contractor shall provide pipe sizes required for a code compliant and fully functional system. Pipe sizes shall be determined by the contractor's hydraulic calculations and show on the contractors Shop Drawings.
- C. Sprinklers shall be located in a symmetrical pattern related to ceiling features such as grid, beams, light fixtures, diffusers, etc. and where applicable, heads shall be located symmetrically with the ceiling grid, centered in two directions. Locate heads to provide code required distances away from lights, exit signs, etc., and all other items that could interfere or effect sprinkler discharge.
- D. Apply temporary protective covers during construction to ensure that sprinklers and escutcheons do not receive field paint.
- E. Route piping in orderly manner, plumb and parallel to building structure and concealed above ceilings where possible. Locate concealed valves, switches and alarm connections in accessible location, and coordinate size and location of access panels/doors with General Contractor.
- F. Provide an electrically operated audio/visual horn and strobe device.
 - 1. At the building exterior, directly above the fire department connection.
- G. This Contractor's work shall extend to 5 feet beyond exterior wall as indicated on drawings.
 - 1. Where a free-standing fire department connection or free-standing fire pump test header is provided, this contractor's work shall include piping to this equipment.
- H. No work shall be concealed where it is inaccessible unless inspected and approved by the authorities having jurisdiction.
- I. Install piping to conserve building space and not interfere with use of space and other Work. Coordinate with other trades to avoid conflicts and provide all required offsets, piping, auxiliary drains, etc. to properly install system. Where piping installation conflicts with the installation of other trades during construction, piping shall be removed and re-routed at no additional cost.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.

- K. Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition.
- L. Install sprinklers in lay-in ceilings with return bend or flexible connector.
- M. Install drain piping at low points of piping system.
- N. Install drain risers as indicated and as required by NFPA 13.
- O. Electrical contractor shall wire supervisory switches the building fire alarm panel.
- P. Sprinkler Piping Flushing: Prior to connecting sprinkler risers, flush water feed mains and lead-in connections.
- Q. Piping is to be held as high as possible where exposed.
- R. Wet system pipe may be installed level as per NFPA 13.
- S. Provide return bends connected to the top of branch lines, or flexible sprinkler drops connected to the side of branch lines, to all pendent sprinklers as shown on drawing details.
- T. Contractor shall arm-over from existing branch line outlets to new sprinkler locations.

3.3 PIPING AND FITTINGS

- A. All piping shall be installed in accordance with good commercial practices.
- B. Fire seal all penetrations through fire rated assemblies per specification section 210010.
- C. Piping systems shall be securely supported by U. L. listed hangers with allowance for pipe expansion and contraction; agent thrust forces, and shall not be subjected to mechanical vibration or other damage. Consult ANSI B-31.1.0 for guidance on this matter. Hangers shall be spaced according to manufacturer's recommendations.
- D. Install building attachments within concrete or to structural steel. Piping shall not be supported from joist bridging or a roof metal deck.
- E. All pipe lengths shall be reamed, blown clear and swabbed with suitable solvents to remove butts, mill varnish and cutting oil before assembly.
- F. After cutting, pipe ends shall be thoroughly cleaned. Before installing nozzles, piping shall be blown out with dry air or dry nitrogen to ensure the system is free of debris.
- G. For threaded fittings, teflon tape dope only shall be used and applied to male pipe threads only.

3.4 TESTING

- A. The entire automatic sprinkler system shall be tested in the presence of an authorized representative of the Engineer and the governing agencies having jurisdiction for approval. Advance notice of 24 hours is required.
- B. The installing Contractor shall complete and sign the appropriate Contractor's Material and Test Certificates included within NFPA 13 and 14.
- C. All interior sprinkler piping shall be pressure tested hydrostatically at not less than 200 P.S.I. for two (2) hours. Hydrostatic testing shall be performed in accordance with NFPA 13. Interior sprinkler piping shall be installed in such a manner that there will be no visible signs of leakage or pressure drop for the duration of the hydrostatic pressure test.
- D. The Contractor's Material and Test Certificate as shown in NFPA 13 must be completed and submitted to the Engineer before final approval may be given.
- E. Preliminary testing procedures shall be conducted as mentioned above to assure proper operation when the final testing is performed.
- F. Repair or replace piping system as required to eliminate leakage in accordance with NFPA standards and retest as specified to demonstrate compliance.

END OF SECTION 210500

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SECTION 220000 – PLUMBING GENERAL CONDITIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 220000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The plumbing work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- E. It shall be a part of this Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.
- F. Rough-in for and connect, as shown on the drawings, facilities for equipment furnished by the Owner under a separate contract.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

International Building Code - 2024
International Plumbing Code - 2024
International Mechanical Code - 2024
International Fuel Gas Code - 2024
International Fire Code - 2024
National Electrical Code / NFPA 70 - 2011/2023
NFPA 13-2010/2022
ASHRAE STANDARD 90.1 - 2022

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Piping, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all pipe, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as pipe arrangement, fittings, specialties, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders

of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.

- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This Contractor, before submitting his bid, shall visit the site and thoroughly acquaint himself with conditions under which the work will be performed.
- B. Failure to fully acquaint himself with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract. See General Conditions for additional requirements.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to:

SSC Engineering
Attention: Submittals

18207 Edison Ave.
Chesterfield, MO 63005

4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the Contractor marked accordingly.
- E. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- F. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- G. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- H. Shop drawings shall include the plan mark used on the plans.
- I. Valve and fitting shop drawings shall indicate the intended service.
- J. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- K. Submittals which do not provide the required information will be returned unchecked.
- L. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- M. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- N. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the

specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.9 RELEASE OF CAD FILES

- A. See "Release of Cad Files" at the end of this section.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- D. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Complete set of shop drawings.
 - 2. Copies of all submittals.
 - 3. Parts lists, wiring diagrams, piping diagrams, etc.
 - 4. Manufacturers' operating and maintenance instructions.
 - 5. As-built drawings.
 - 6. Written operating and maintenance instructions for the system.
 - 7. Copies of warranties.
 - 8. Parts list for each piece of equipment and name of local supplier.

- E. At a predetermined time, prior to building occupancy, an instructional session shall take place. The installing contractors and major suppliers shall instruct the Owner's operating personnel on operation and maintenance of the systems. The installing Contractor shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.11 RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of piping, specialties and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 WORKMANSHIP AND MATERIALS

- A. All work shall be performed in a manner acceptable to the Engineer, Architect, and the Owner, by properly trained, supervised and experienced personnel using new and clean materials, supplies, equipment, and hardware.

1.13 MATERIAL AND EQUIPMENT HANDLING AND STORAGE

- A. It is recognized that space at the project for storage of materials and products is limited. Coordinate the deliveries of materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment to the project substantially ahead of the time of installation.

1.14 GUARANTEE AND WARRANTY

- A. This Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year from final acceptance in accordance with the General Conditions.
- B. During the guarantee period, this Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required during this period at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this Contractor's bid. This contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.
- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall furnish all material, equipment, labor, services, supplies, etc., required to execute to completion all work shown on the plumbing drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. This Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, this Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.

- B. If this Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, this Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the Contractor furnishing the controlled equipment.
- F. Unless noted otherwise, the Electrical Contractor shall furnish and install all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Magnetic motor starters will be provided with:
 - 1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 - 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.
- G. The Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, pilot controllers (aquastats, flow switches, pressure switches, etc.) shall be furnished and mounted by the Contractor furnishing the controlled equipment.
- I. Unless specifically noted otherwise, thermal wells for temperature control system sensors shall be provided by the Temperature Control Contractor and installed by the Plumbing Contractor or other contractor as indicated.
- J. Unless specifically noted otherwise, control valves shall be furnished and installed by the Plumbing Contractor or other contractor as indicated.
- K. Electrical Work For Plumbing Equipment: Electrical Contractor to wire all plumbing equipment furnished by this contractors in accordance with the following general provisions:
 - 1. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer's wiring diagram.

2. Receive, unload, set and align all separately shipped motors. Adjust and align drive and adjust belt tension.
3. Field lubricate all motors prior to initial operation of same.
4. Install individual motor starters specifically called for to be furnished by other Contractors when not a factory pre-wired component.

L. Plumbing Contractor shall provide the following:

1. All equipment, motors, disconnect switches or control devices specifically called for.
2. Automatic control and interlock wiring diagrams as called for in the specifications.
3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
4. Adjustable motor bases and all bolts and nuts required for installation of base and motor.
5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This Contractor shall cooperate with and coordinate with the Owner's Representative to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. All interruptions shall be scheduled, and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.
- D. Pipes which are shown to be installed or demolished in subsequent phases that are needed for earlier phases to make the earlier phase operational shall be installed or demolished in the earlier phase during non-business hours. Where later phase work is performed in an earlier phase, contractor shall remove and replace ceilings as required to perform the work.

3.5 DEMOLITION OF FACILITIES

A. General

1. The demolition work shall consist of removal of plumbing equipment and related piping pertaining to the installation and modifications of the plumbing systems as indicated on the drawings.
 - a. Piping to Be Removed: Drain piping and remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
2. Contractor shall note the project is a renovation to an existing building. The building shall remain in operation at all times during the construction. Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.
3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The Contractor shall be responsible to field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
4. Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the plumbing drawings.
5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
7. All plumbing equipment to be reused shall be disconnected, marked and protected where necessary.

B. Existing Conditions

1. Contractor shall exercise great caution when performing demolition work to prevent damage to existing systems or items of work that are to remain. If Contractor damages,

removes or destroys an existing system which is to remain, Contractor shall repair or replace that system to its original condition.

2. Unless specifically stated otherwise on the plans, where access to plumbing items is required, Contractor shall provide the required access by removing ceilings, cutting openings, etc., as required. Prior to cutting openings, this Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the General Contractor. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.
3. Repair of openings is a part of this Contractor's work. Work shall be performed by the proper trades. Materials which are removed, damaged, or soiled shall be replaced with new materials. Ceilings and walls shall be repaired and restored to as close to the original condition as possible. This shall include replacement of surface finish materials such as paint, plaster, drywall, ceiling tile, etc.
4. Repair of floor openings and trenches is a part of this Contractor's work. Floors shall be repaired to match the level and surface finish of the existing concrete and flooring finishes.
5. Areas shall be repaired with materials matching those which have been removed.
6. Contractor shall repair streets, sidewalks, parking lots and reseed grassed areas which have been altered by his work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. Contractor shall minimize any spread of dust, debris and flying particles. Demolition shall not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, this Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Disposition of Material

1. Those items of material and equipment to be removed by this Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

E. Hazardous Materials

1. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect, Engineer, and Owner. Owner will remove hazardous materials under a separate contract.
2. Where insulation containing hazardous materials is removed from piping and equipment, it shall be replaced with new insulation. See specification 220400, Plumbing Systems.

3.6 RELOCATION OF EXISTING EQUIPMENT

- A. Some items of existing equipment are to be relocated as indicated on the drawings. All utility connections in the existing location shall be disconnected by this Contractor. This Contractor shall reconnect the utility in the new location. These utilities include electric and piping. The equipment shall be moved from the existing location to the new location as indicated on the drawings.
- B. Unless otherwise indicated, equipment shall be relocated in the condition in which it exists before relocation begins. This Contractor is not responsible for reconditioning existing equipment unless otherwise indicated. Prior to disconnecting any utilities and prior to placing the equipment out of service, this Contractor shall, in the presence of the Owner's Representative, inspect all items or equipment scheduled for relocation and shall document deficiencies which might affect this Contractor. After the equipment is in place in its new location, it shall be the responsibility of this Contractor to reconnect the utilities and place the equipment into proper operation.
- C. This Contractor shall be responsible for damage done to the equipment during relocation. Except for the documented deficiencies, all deficiencies shall be considered to have occurred during relocation, in which case this Contractor shall repair or replace at no additional cost to the Owner.

3.7 MAINTENANCE OF WORK AREAS

- A. During the project this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

- A. Upon completion of this work, the Contractor shall clean all pipe, fixtures, and equipment. Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. This contractor shall be responsible for his own cleanup to a central location designated by the General Contractor. Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work.

END OF SECTION 220000

RELEASE OF CADD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2023. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CADD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 220010 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. This section covers basic plumbing materials and methods for Plumbing work and applies to work of those sections.

1.2 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. All Supports
 - 2. Pipe Seals and Pipe Stands
 - 3. Sealants
 - 4. Pipe Markers

PART 2 - PRODUCTS

2.1 PRODUCT CRITERIA

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration

NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED PIPE SEALS

A. Seals for Roof Penetrations:

1. Prefabricated pipe seals shall have a one piece spun aluminum base with a 5" high roof surface flange sloped for runoff. Unit shall have a PVC boot with graduated widths and adjustable stainless steel clamps. Unit shall withstand expansion, and vibration and shall fit pipe sizes from ½" through 10" be heavy-gage, galvanized steel curb with mitered and welded corners; 1-1/2-inch-thick
2. Equal products, complying with these specifications by the following manufacturers are acceptable:
 - a. Pate
 - b. Roof Products & Systems
 - c. Thycurb
 - d. Approved Equal

B. Seals for Floor or Foundation Wall Penetrations:

1. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

2.4 FLASHING

A. Metal Flashing: 26 gage galvanized steel.

- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.6 ACCESS PANELS SHALL COMPLY WITH THE FOLLOWING

- A. Access panels shall be constructed of heavy gauge steel with factory applied prime coat of baked enamel.
- B. Panel doors shall be attached to the frame with concealed hinges.
- C. Cam locks shall be provided in not less than the following quantities:

Panel Height (Opposite side of hinges)

0 to 18"	1 cam lock
18-1/16" to 30"	2 cam locks
30-1/16" to 48"	3 cam locks
48-1/16" to 60"	4 cam locks

Panel Width

0 to 18"	No cam locks on top or bottom
18-1/16" to 30"	1 cam lock top and bottom
30-1/16" to 48"	2 cam locks top and bottom

- D. On the panel height, one of the cam locks described above shall be a key operated cylinder lock in lieu of the cam lock. One key shall operate all panels.
- E. Cam locks shall have tamper-proof heads. Provide 10 tools to the owner.
- F. For masonry, tile or wallboard surfaces, provide access panels with extruded aluminum frames, 3/4" border, aluminum piano hinges, screwdriver-operated cam lock, brushed satin aluminum finish. Final painting to match interior decor by others. Paintable finish to be provided when the adjacent construction is paintable.
- G. Access panels will not be required in accessible type ceilings.
- H. For plastered ceiling or wall, concealed flange, recessed door panel to receive plaster by others, continuous hinges, flush latch, white prime coat finish. Final painting to match interior decor by others.

- I. For Fire Rated Partition - Access doors in fire rated walls shall be 1-1/2 hour (B) rated and shall bear the UL label. Doors shall be fabricated of steel and shall be provided with baked enamel prime coat over a phosphate coating.
- J. For locations concealed from public, snap catch latches may be used.
- K. Manufacturer - Access panels shall be equal to Inryco/Milcor type K for plaster, type DW for drywall, type M for masonry.

2.7 SLEEVES

- A. Exterior and Foundation Walls: All piping through exterior or foundation walls shall pass through schedule 40 galvanized steel sleeves which shall be large enough to allow for caulking material. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved by the Engineer.
- B. Interior Walls and Partitions: All piping through interior walls and partitions that are fire rated shall pass through either schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves. Schedule 40 steel pipe sleeves must be used when required for structural purposes. Sleeves are not required for automatic control tubing.
- C. Floors: All piping through elevated floor slabs shall be provided with schedule 40 carbon steel pipe sleeves, extending 2 inches above floor except in finished areas. Sleeves in finished areas shall terminate flush with floor, and shall be schedule 40 carbon steel pipe.

2.8 BACKING & SEALANTS

- A. Backing and sealant for piping passing through floors, plaster ceilings, partition, and walls shall be as follows:
 - 1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
 - 2. Sealant: Gun Grade. A 1-part modified polyurethane, gun applied, elastic sealant, "Dymonic" by Tremco, or Chem-Calk 900 by Bostik. Sealant shall be low VOC and shall satisfy the LEED criteria for EQc4.
 - 3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
 - 4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Sealant shall be low VOC and shall satisfy the LEED criteria for credit EQc4. Subject to

compliance with requirements, provide fire retardant sealant products from one of the following:

- a. "SpecSeal" by Specified Technologies Inc.
- b. 3M
- c. Chase Technology Corporation
- d. Link-Seal
- e. Pyro-Pac by Thunderline Corporation
- f. "Fyre Seal" by Tremco
- g. Pensil 100 by General Electric
- h. Pensil by STI
- i. "Flameseal" by G. S. Nelson Electric.

5. Fire-Retardant Sealants:

- a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
- b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
- c. Fire stop putty. "Flameseal" by G. S. Nelson Electric.
- d. Intumescence Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to >1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.
- e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.
- f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.
- g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive

adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.

- i. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≤ 52 lb./cu.ft., dry mortar density shall be ≤ 45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.
- j. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.
- k. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.
- l. Intumescent Wrap Strips:
 - 1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.
 - 2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.

2.9 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.10 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, equipment, etc., shall be furnished and installed by this Contractor.
- B. Lintels furnished shall be structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.11 CUTTING

- A. All openings for pipes etc., shall be provided by this Contractor by means of sleeves or framed openings.
- B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., this contractor shall obtain the Owner's approval in advance of the cutting and patching.

- C. Contractor shall be responsible for any cutting required for pipes, etc., if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- D. Prior to cutting or core drilling of structural concrete slabs, contractor shall locate steel reinforcing bars using x-ray or other approved methods. Location of holes shall be adjusted to locations that will not damage reinforcing bars; coordinate locations with the Structural Engineer.
- E. Where trenches are cut in the floor slab that contains structural reinforcing, reinforcing bars in the floor shall NOT be saw cut flush with the edge of the trench. See details on the structural drawings for retaining stubs of reinforcing bars (in both directions where this occurs) so they may be repaired and reinstalled as detailed by the structural engineer OR if not detailed on the structural drawings, contact the Structural Engineer before cutting begins to determine the course of action.
- F. Concrete for patching trenches in the floor slab shall be in accordance with Section 033000 (do not use the concrete specification in this section for patching structural concrete floor trenches.)

2.12 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.
- C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.13 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be Allen Systems, Inc., W.H. Brady Co.- Signmark Div., or Industrial Safety Supply Co., Inc.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.

- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high letters. Provide 5/32" hole for fastener. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for proper attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name and plan number, 2) Equipment service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.14 UNDERGROUND PIPING MARKERS

- A. Tape: Triple-laminate, consisting of aluminum foil, polyester film, and polyethylene, 6" wide.
- B. Colored background, black lettering, two lines wide, and 2" tall letters. Provide different color tape for each piping service.
- C. Acceptable Manufacturer, subject to compliance with requirements: Panduit Corporation.

2.15 CEMENT GROUT

- A. Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.16 CONCRETE

- A. Reinforcing Materials
 - 1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.
 - 2. Welded Wire Mesh: Welded plain cold-drawn, ASTM A 185. Furnish in flat sheets, not rolls.
- B. Concrete Materials
 - 1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
 - 2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
 - 3. Water: Potable.
 - 4. Air-Entraining Admixture: ASTM C 260.
 - 5. Water-Reducing Admixture: ASTM C 494, Type A.

6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
3. Design mixes to provide normal weight concrete with the following properties:
 - a. 4000 psi 28-day compressive strength.
 - b. 4,500 psi 28-day compressive strength at exterior locations where snow maintenance will be utilized.
4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
 - a. Interior 2 - 4%.
 - b. Exterior 4.5 – 7.5%.
2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Slump Limits

1. Proportion and design mixes to result in concrete slump at point of placement at not less than 2" and not more than 4".

2.17 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall furnish and install all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, piping, etc., furnished and installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Provide concrete housekeeping pads a minimum of 3-1/2" high, unless detailed otherwise, under all equipment, heaters, tanks, etc., in the equipment rooms where piping containing water is located. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be 1/2" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.

3.2 PIPE PROTECTION DURING CONSTRUCTION

- A. Protect pipe interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.3 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. This Contractor shall ascertain from his examination of the architectural and structural drawings whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary.
- B. The Contractor shall pay all cost of making such openings or providing such supports.

3.4 CUTTING AND PATCHING

- A. All cutting that may be necessary for the installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut.

- B. No openings shall be cut without written approval of the Owner's Representative.

3.5 ROOF PENETRATIONS

- A. Any penetration of the roof shall be provided with an appropriate roof penetration apparatus as herein described.
- B. Penetrations of ICC 500 rated roofs require rated device.
- C. Cutting of the metal decking for all unframed openings is the responsibility of the Contractor requiring the opening. Cutting, patching and flashing of roof shall be the responsibility of the Contractor needing the opening. The original roof warranty shall be maintained.
- D. When penetrations occur in an existing roof, the penetrations shall be made in the presence of the Owner, roof installer or General Contractor. If the penetration reveals any indication of wet or damaged roof, insulation, subroof or structure, all roof work by this contractor shall stop and the Owner shall be notified in writing as to the conditions found.
- E. At all times during construction, this Contractor shall provide temporary covers, enclosures, etc., required at roof openings to prevent injury to personnel and to prevent outdoor elements (water, wind, etc.) from entering the opening.

3.6 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.7 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor requiring access shall provide access panels.
- C. Contractor shall not provide access panel to equipment above drywall ceilings without written permission of Architect/Engineer.

3.8 PAINTING

- A. All pieces of plumbing equipment shall be factory finished machinery-grey, or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.

- B. This Contractor shall paint the following items:
 - 1. Items specified under "Demolition and Restoration of Facilities", Section 220000 shall be painted.
 - 2. All uninsulated piping installed outdoors shall be painted, primer plus one coat enamel, color selected by owner.
 - 3. No other painting is required unless specifically called for on the plans.

3.9 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves in foundation walls or footings shall be as detailed on the plans.
- C. Sleeves through floors shall extend 2" above finished floors.
- D. Sleeves in foundation walls or footings shall be as detailed on the plans. No sleeves, other than those shown on the drawings, shall be installed through footings or foundations without obtaining approval from the Structural Engineer.
- E. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. Sleeves shall be grouted in place.
- F. Where pipes pass through existing foundation walls or concrete walls below grade, the hole shall be core drilled.
- G. Where pipes pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.
- H. The internal diameter of sleeves shall be 1" to 2" larger in diameter than the outside diameter of the pipe or pipe insulation. Insulation shall be continuous through sleeve.
- I. The space between the pipes and sleeves shall be sealed as follows:
 - 1. Exterior walls above grade: Caulking shall be applied to a minimum 3" total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½" in depth, finishing flush with the wall.
 - 2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer's instructions.
 - 3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3" recessed ½" below the finished floor or roof. This ½" recess shall then be filled with sealant to flush with finished floor or roof.
 - 4. Interior Non-Rated Walls/Partitions:

- a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe to 1" maximum. The space between the duct or pipe and the wall may be left open.
 - b. Visible Locations: Openings between pipe and wall shall be covered with a chrome plated escutcheon.
 - 5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.), the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.
 - J. Shop drawings shall be submitted on all fire resistant materials and methods.
- 3.10 PIPING AND EQUIPMENT SYSTEMS MARKERS
- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 - 1. Adjacent to each valve.
 - 2. At each branch or riser take-off.
 - 3. Where piping goes through floors, walls or ceilings.
 - 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
 - B. All color coding shall comply with ANSI A13.1 1975.
 - C. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.
 - D. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.
 - E. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and plan number and B) Equipment service, matching terminology on schedules as closely as possible.
- 3.11 LINES AND GRADES
- A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.
 - B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.12 EXCAVATION

- A. Excavate, as necessary, for all underground piping as indicated on drawings and/or necessary.
- B. Material to be excavated shall be nonclassified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.
- C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.
- D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed $4/3$ of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.
- E. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, and fittings. Remove projecting stones and sharp objects along trench subgrade.
- F. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.
- G. Grading in the area of the excavation shall be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- H. Where underground pipes cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Pipes which run parallel and at different levels shall be adequately separated to provide firm bedding for the pipes. Sewer, water and gas pipes shall be run in completely separate trenches, and at least three (3) feet apart at center lines, except as approved by the Engineer. Whenever possible, water pipes shall be installed above sewer pipes and gas piping above water and sewer pipes.

3.13 BEDDING AND BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.
- B. Trenches for sewers, piping, etc., shall be backfilled for a depth of at least six (6) inches over the top of pipe with sand. Bedding shall be provided in the form of six (6) inches of sand under the pipes. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 0'-6" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 0'-6" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, recompact, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 220010

SECTION 220020 – PLUMBING SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide seismic restraints as indicated for each type of equipment and for piping systems. This section applies to:
 - 1. Plumbing Systems
- B. Scope of Work
 - 1. The following items of equipment shall have flexible pipe connectors installed at the piping connection to the items:
 - a. Water pumps where indicated on the plans.
 - 2. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
 - 3. Seismic control manufacturer shall have the following responsibilities:
 - a. Determine seismic restraint sizes and locations.
 - b. Provide piping and equipment seismic restraints as scheduled or specified.
 - c. Provide installation instructions and drawings.
 - d. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
 - 4. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 5. All piping shall be restrained per the latest revision of SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

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.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Material and Methods.

1.3 REFERENCES

- A. NFPA Standard 13

- B. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 2008.

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: See Schedule on drawings.
 - b. Component Response Modification Factor: See Schedule on drawings.
 - c. Component Amplification Factor: See Schedule on drawings.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 21.3%.
 - 4. Design Spectral Response Acceleration at 1-Second Period: 16.7%.
 - 5. Seismic Design Category: D.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select seismic restraints.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Seismic Details:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.
 - c. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
 - C. Coordination Drawings: Show coordination of seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
 - D. Welding certificates.
- 1.7 QUALITY ASSURANCE
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
 - B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- 1. Refer to specification 200800.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark seismic control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 200800

END OF SECTION 220020

SECTION 220400 – PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Work under the Plumbing Contract shall include, but is not limited to, all labor, materials, equipment, tools, controls, fees, etc., required to install, test, and start-up the systems described below and/or shown on the contract drawings.
 - 1. New Plumbing Specialties.
 - 2. New Plumbing Piping Insulation.
 - 3. New Domestic Hot and Cold Water Piping.
 - 4. New Sanitary Waste Piping and Vent Piping.
 - 5. New Storm Water Piping.
 - 6. Insulation for Plumbing piping and equipment requiring insulation.
 - 7. Any miscellaneous items required by applicable plumbing or building codes to meet improvements noted in plans or in these specifications herein.
 - 8. Any miscellaneous or customary items required to provide acceptable performance of the fixtures and systems specified in the plans and in these specifications.
 - 9. Installation or final connections of Owner furnished equipment as indicated on the drawings.
- B. The drawings are generally diagrammatic. Unless specifically shown, the drawings shall not be scaled for positioning of piping, fixtures, or equipment. This Contractor shall coordinate his work with the Architectural drawings and with all other trades in regard to placement of facilities. Contractor shall refer to architectural and structural plans for building construction and dimensions. Refer to architectural "Room Finish Schedules" for material and finish of walls, floors and ceiling so proper roughing-in may be provided.
- C. All plumbing work shall be in accordance with the local plumbing code, the requirements of the Building Code and the Seismic requirements defined in Section 220020 and with seismic details on drawings. If any of these documents are in conflict with the local code authority, the discrepancy shall be noted by the Contractor and sent to the Engineer prior to initiating any work.
- D. All permits and inspection fees required to do this work shall be paid for by Plumbing Contractor. At the completion of the work, the Contractor shall furnish a certificate of approval showing that his work has been approved and accepted by the proper inspection authorities.
- E. Contractor shall be responsible for utility connections.
- F. Excavate for all underground work that requires excavation. See Section 220010 of this specification for excavation and backfill requirements.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220020 - Seismic Restraints.

1.3 EQUIPMENT FURNISHED BY OTHERS

- A. Where specifically indicated, some items of equipment will be furnished by the Owner or under other Divisions of these specifications.
- B. Unless specifically noted otherwise for the items furnished by others, this Contractor shall receive, locate, set in place, rough-in and make final connections to all items requiring plumbing connections.
- C. Unless specifically noted otherwise, for the items furnished by others, this Contractor shall furnish and install all piping, stops, traps and accessories required to make final connection.

1.4 FIXTURES FURNISHED BY OTHERS

- A. Where specifically indicated on the plans, sinks, disposals, etc., will be furnished and set in place by others. This Contractor shall furnish:
 - 1. P-trap
 - 2. Angle Stop Valves.
- B. This Contractor shall receive and install these items and make final connections.

1.5 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. Valves and Piping Specialties
 - 2. List of all proposed piping material and its intended use.
 - 3. Insulation: Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each system requiring insulation.
 - 4. Hangers and Supports: Submit schedule showing Manufacturer's figure number, size, location, and features for each hanger and support.
 - 5. Water system pre and post testing per ASHRAE 188-2018.

1.6 QUALITY

- A. Comply with the provisions of the following:
 - 1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

B. References

1. ASHRAE 188-2018 Legionellosis: Risk Management for Building Water System
2. ASME B16.18 Cast Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
4. ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
5. ASTM A 74 Cast Iron Soil Pipe and Fittings
6. ASTM A 888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
7. ASTM B 32 Solder Metal
8. ASTM B 88 Seamless Copper Water Tube
9. ASTM B 306 Copper Drainage Tube (DWV)
10. ASTM B 813-2010 Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.)
11. ASTM B 828 Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
12. ASTM C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
13. ASTM D 1784 Rigid Poly Vinyl Chloride Compounds and Chlorinated Poly Vinyl Chloride Compounds
14. ASTM D 1785 Poly Vinyl Chloride Plastic Pipe, Schedules 40, 80, and 120
15. ASTM D 2241 Poly Vinyl Chloride Pressure-Rated Pipe (SDR Series)
16. ASTM D 2321 Standard Practice for Underground PVC Pipe Installation
17. ASTM D2447 Polyethylene (PE) Plastic Pipe, Schedule 40 and 80
18. ASTM D 2464 Threaded Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 80
19. ASTM D 2466 Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 40
20. ASTM D 2467 Socket-Type Poly Vinyl Chloride plastic Pipe Fittings, Schedule 80
21. ASTM D 2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
22. ASTM D 2657 Heat-Joining Polyolefin Pipe and Fittings
23. ASTM D 2661 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
24. ASTM D 2665 Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
25. ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping
26. ASTM D 2855 Making Solvent-Cemented Joints with Poly Vinyl Chloride Pipe and Fittings
27. ASTM D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
28. ASTM D 4101 Propylene Plastic Injection and Extrusion Materials
29. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
30. ASTM E 814 Standard Test Method for Fire Test of Penetration Fire Stop Systems
31. ASTM F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
32. ASTM F 1290 Electrofusion Joining Polyolefin Pipe and Fittings

33.	AWS A5.8	Filler Metals for Brazing and Braze Welding
34.	AWWA M23	Manual: PVC Pipe - Design and Installation
35.	AWWA	Disinfection Building Potable Water Plumbing in New or Repaired Systems November 2024
36.	CISPI HSN	Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
37.	CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
38.	CISPI 310	Mechanical Compression Coupling
39.	NSF/ANSI 61	Drinking Water System Components
40.	NSF/ANSI 372	Drinking Water System Components - Lead Content
41.	ASTM C 547	Standard Specification for Mineral Fiber Pipe Insulation.
42.	ASTM C 1136	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
43.	ASTM C 585	Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

C. NSF Compliance

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Interior Domestic Water Piping (Copper)

1. Interior Pipe 4" and Smaller:
 - a. Pipe below grade shall be copper, ASTM B88, Type K, soft copper tube annealed temper. No joints shall be allowed below slab.
 - b. Pipe above grade shall be copper, ASTM B88, Type "L" hard copper tube, drawn temper.
2. Fittings and Solder for Copper Tubing:
 - a. All solder fittings shall be wrought copper or cast bronze solder fittings and shall bear manufacturer's trade mark. ASME B16.18 or B16.22 pressure fittings.
 - b. Solder shall be 95-5 complying with ASTM B32; flux shall be ASTM B 813, water flushable type, for 4" and smaller.
 - c. Bronze Fittings for Roll Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings. For NPS 2-1/2" thru 4". Wrought copper or cast copper alloy roll groove fittings utilizing no-sweat coupling and flange adapter assemblies.

3. Piping exposed to view shall be chrome plated unless otherwise indicated on the plans.
- B. Sanitary Waste, and Vent Sewer Piping and Storm Water Piping
1. See application criteria in Part 3 below.
 2. Bell and Spigot Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: ASTM A74.
 - b. One piece elastomeric compression type gaskets: ASTM C564.
 - c. Pipe and fittings shall be encased with 8 mil thick polyethylene: AWWA C105.
 3. No Hub Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: CISPI 301.
 - b. Mechanical compression coupling with neoprene gasket and stainless steel band and accessories: CISPI 310.
 - c. Heavy Duty Mechanical compression coupling with neoprene gasket and 304 stainless steel band and accessories. Comply with ASTM C-1540; gasket shall conform to ASTM C564. Husky model SD 4000 orange band. No equals allowable.
 4. Copper Tubing and Fittings:
 - a. Copper drainage tubing (DWV): ASTM B 306.
 - b. Wrought copper solder type fittings: ASME B16.29.
 - c. Joints: 95/5 type solder. ASTM B 32.
- C. Valves
1. Water Valves:
 - a. All valves of the same type shall be of the same manufacturer.
 - b. All valves shall be lead free complying with NSF-61-G and ANSI 372.
 - c. Valves shall be as indicated using the Nibco figure numbers or the approved equal as manufactured by Crane, Jenkins Bros., Hammond, Milwaukee, Powell, Stockham or Walworth.
 - d. For CW piping systems with 2" or less insulation, provide extended handles on stop valves with a vapor seal, adjustable memory stop and convenient valve packing maintenance - all without disturbing the insulation. Extended valve handles shall be Nibco NIB-SEAL or equal.
 2. Stop valve sized through 2" shall be:
 - a. Nibco Fig. No. T-585-66-LF (threaded), full port 400 psi WOG non-shock at 100°F, 2-piece construction, stainless steel ball and trim and bronze body with Teflon O-ring seals and seats.
 3. Stop valve sized 2-1/2" and larger shall be:

- a. Non-shock cold water, butterfly valves. Standard: MSS SP-67, Type I. CWP Rating: 2"-6" = 200 psig; 8"-10" = 150 psig. Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange. ASTM A 126, cast iron or ASTM A 536, ductile iron. Seat: EDPM. One- or two-piece stainless steel stem. Aluminum bronze disc. Nibco Fig. No. LC-2000-3 200 psi.
- 4. Check valves through 3" shall be threaded swing check valves. Nibco Fig. No. T-433.
- 5. Balance Valves
 - a. Calibrated
 - 1) Valves shall be calibrated bronze balance valves with provisions for connecting a portable differential pressure meter.
 - 2) Meter connections to have built-in check valves.
 - 3) An integral pointer shall register degree of valve opening.
 - 4) Internal seals to prevent leakage around rotating element, suitable for 100% shut-off.
 - 5) Rated for 150 pounds working pressure at 250°F
 - 6) Supplied with preformed polyurethane insulation.
 - b. Self-actuating thermostatic
 - 1) Valve shall automatically and continuously adjust flow to maintain a specified temperature at the end of each piping branch or riser.
 - 2) Compliant with the Buy America Act
 - 3) Lead free & NSF 61 Certified
 - 4) 3 year warranty
 - 5) Tamper Proof - Fixed set-point
 - 6) Stainless steel - corrosion resistant
 - 7) ½" through 2"
 - 8) High Cv

2.2 Y-PATTERN STRAINERS

- A. Manufacturer: Subject to compliance with requirements, provide domestic water piping system products from one of the following:
 - 1. Armstrong Machine Works
 - 2. Keckley
 - 3. Illinois
 - 4. Mueller Steam Specialty
 - 5. Metraflex Co.
 - 6. Spirax Sarco.
- B. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- C. Body: Bronze for NPS 3 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 4 and larger.

D. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

E. Screen: Stainless steel with round perforations, unless otherwise indicated.

F. Perforation Size:

1. Strainers thru NPS 2-1/2 inch: #20 mesh.
2. Strainers NPS 3: 3/64 inch.
3. Strainers NPS 4 and Larger: 1/8 inch.

G. Drain: Pipe plug.

2.3 UNIONS

A. All unions shall be streamline ground joints, Mueller Streamline or approved equal. Dielectric unions may be solder joint, screwed or flanged. Dielectric connections shall be Victaulic Dielectric waterway or equal.

2.4 VACUUM BREAKERS

A. This Contractor shall furnish and install vacuum breakers in the following locations where a vacuum breaker is not an integral part of the fixture:

1. All water closet flush valves.
2. All urinal flush valves.
3. All wall hydrants and all hose bibbs.
4. Janitor's sinks and mop basins.
5. Shelf mounted water heaters.

B. In addition to the above locations, vacuum breakers shall be installed where required by governing local authorities, on all connections to domestic water system to which hoses could be attached and all connections to the domestic water system where back siphonage could occur.

2.5 PIPE INSULATION

A. The piping insulation material is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:

1. Owens-Corning
2. Johns Manville
3. Knauf Insulation
4. Armacell
5. Rubatex
6. Manson Insulation

B. Insulation material:

1. Type (1) – Fiberglass Preformed Pipe Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C547, Type I. Fiberglass with factory-applied, ASJ SSL+ all service polymer jacket with self- sealing lap down joints and butt strips, complying with ASTM C1136. Vapor barrier in jacket. Thermal conductivity shall be 0.23 BTU/HR/SF°F/IN @ 75°F mean temperature, 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F or less.
 2. Type (2) – Flexible Elastomeric Insulation: (Plenum rated) foamed plastic flexible tubing insulation. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 100°F mean temperature.
- C. The installed insulating system shall comply with the requirements of the National Fire Protection Association. Insulation, including finishes and adhesives, on the exterior surfaces of pipes and equipment shall have a flame spread of 25 or less and a smoke developed rating of 50 or less as determined by an independent laboratory in accordance with ASTM E84/UL 723.
- D. Piping insulation material shall be plenum rated with UL listing.
- E. All insulation shall be rat, vermin, germ, fungus and rot resistant.
- F. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.
- G. See Part 3 - Execution for items to be insulated.
- 2.6 HANGERS
- A. Manufactured Units
1. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.
 - a. Hangers: Types 5 and 12 shall not be used.
 - b. Hangers: Type 3 shall not be used on insulated piping.
 - c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 - d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
 - e. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.
 2. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Grinnell also acceptable.

a. Clevis Hanger	Fig. B 3100
b. Adjustable Swivel Ring	Fig. B 3170
c. Adjustable Swivel Roller	Fig. B 3111
d. Adjustable Roller Support	Fig. B 3121 or Fig. B 3122
e. Riser Clamp (Standard Duty)	Fig. B 3373

- f. Riser Clamp (Heavy Duty) Fig. B 3131
- g. Offset Clamp Fig. B 3148
- h. Wall Bracket (Light Duty) Fig. B 3068
- i. Wall Bracket (Medium Duty) Fig. B 3065
- j. U-Bolts Fig. B 3188
- k. Structural Attachments:
 - Beams clamps: Fig. B 3031, B 3033, B 3034, B 3050, B 3045
 - Angle Iron Beam Clamp: Fig. B 3046
 - Bar Joist: Fig. B 3059
 - Concrete Inserts: Fig. B 3500, B 2505 thru 2508, or B 3014
 - Drilled Inserts: Phillips Red-head, wedge anchors or equal.

- B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.
- C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the above specifications. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.
- D. Saddles and hangers for insulated piping:

1. Type 40 shields shall:

- a. be used on all insulated pipes less than 12 inches.
- b. have rigid insulation saddle, or insulation pipe hanger consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.
- c. distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

Pipe Size (Inches)	Galvanized Steel Saddle Length (Inches)	Gauge Thickness
½ to 4	12	16
6	18	16
8	24	14
10 and larger	24	14

2.7 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

- c. or equivalent
- 2. Description: Manufactured assembly made of 5.0-lb/sq. ft., 0.0782-inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

PART 3 - EXECUTION

3.1 PIPING APPLICATION

A. Domestic Water Piping Above Ground

- 1. Piping 4" and smaller
 - a. Above Ground Domestic Water Piping shall be copper.
 - b. Above Ground Copper Domestic Water Piping above grade shall be soldered or roll groove fittings as indicated below:
 - 1) Thru 2": Soldered fittings.
 - 2) 2" thru 4": Soldered or roll groove fittings.

B. Sanitary Sewer

- 1. Below Building Slab on Grade Install:
 - a. cast iron hub and spigot
- 2. Above Grade Install:
 - a. hubless cast iron
 - b. Copper sanitary piping.
- 3. Beyond 5 Feet Outside Building Line:
 - a. See Civil Plans.

C. Storm Water Piping

- 1. Below Building Slab on Grade Install:
 - a. cast iron hub and spigot
- 2. Above Grade Install:
 - a. hubless cast iron
 - b. Copper sanitary piping.
- 3. Beyond 5 Feet Outside Building Line:
 - a. See Civil Plans.

3.2 PLUMBING SYSTEMS INSTALLATION

A. Interior Water Piping System

1. The Plumbing Contractor shall furnish all materials and labor to install the cold water, hot water and hot water circulating piping systems. Unless specifically stated otherwise, piping shall be extended and connected to all fixtures or equipment requiring domestic hot and cold water.
2. All piping shall be installed level and plumb. All pipes shall be properly cleaned inside and outside.
3. Provide strainers where indicated on the plans and details.

B. Installation of Piping

1. All pipe shall be run parallel to or at right angles to walls, beams, or columns. Pipe shall be run as direct as possible, but no short cut diagonal methods will be allowed, avoiding unnecessary offsets and maintaining maximum headroom.
2. Piping shall be concealed in finished rooms unless noted otherwise.
3. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed by this Contractor. Pipe and fittings must be installed so that all pipe and/or insulation completely clears all nearby structures, piping and items by other contractors.
4. Piping shall be arranged to allow for expansion and contraction. Expansion loops, expansion joints, and pipe anchors and guides shall be provided on piping mains where shown on the drawings or where required to avoid additional stresses in the piping and supports.
5. Pipes shall not be hung from other piping or from equipment of other trades. No hanger rods or piping shall pierce ductwork.
6. Bull head tee arrangements shall not be allowed.
7. The entire water system shall be free of water hammer. Air chambers shall not be used in place of water hammer arresters. Install water hammer arresters where indicated on the plans and as required for all quick closing valve devices per manufacture requirements. Plumbing fixtures that require water hammer arresters shall include but not be limited to the following:
 - a. Washing machines.
 - b. Dishwashers.
 - c. Mop Service Basins.
 - d. Wall Hydrants.
 - e. Lavatories.
 - f. Water closets.
 - g. Urinals.
 - h. Showers.
 - i. Kitchen sinks.
 - j. Drinking Fountains and electric water coolers.
 - k. Ice makers.
 - l. Kitchen equipment such as coffee machines, etc.

8. Valves shall be installed on each branch and at each piece of equipment, fixture or fixtures group, and all other items requiring water supply shall be separately valved to allow equipment or fixture removal without shutdown of the entire system. All valves shall be located as to be easily accessible. Install valves in horizontal piping with stem at or above the center of the pipe.
9. Use ball and butterfly valves for shut-off duty; ball, and butterfly for throttling duty. Refer to drawings for specific valve applications and arrangements. Use ball valves for isolation on pipe sizes 2" and smaller. Use butterfly valves for isolation on pipe sizes 2½" and larger.
10. Unions shall be installed:
 - a. At piping connections to equipment.
 - b. Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flanges.
11. All valves and specialties must be placed to permit easy operation and shall be made accessible to use, or provided with access panels. Special care must be taken to provide room for removing the inner parts of all specialties. Access panels must be sized properly for maintenance purposes and repairs.
12. If dope, lead or cement is used in making up joints, it shall be based on male threads only.
13. Routing of piping shall be coordinated with other trades to assure adequate space for electrical and mechanical installations above ceilings and in chases. Piping shall not be routed through electrical rooms/closets or elevator equipment rooms.

C. Installation of Hangers and Supports

1. All piping shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitching of pipes, to prevent vibration and excessive deflections, and secure piping in place.
2. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.
3. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe shall not be less than the following schedule: (DI= ductile iron, CI= cast iron, STL= steel, CU= copper)

Pipe Size (Inches)	Maximum Hanger Spacing (Feet)	Minimum Rod Size (Inches)	Maximum Hanger Spacing (Feet)	Minimum Rod Size (Inches)
	DI/CI/STL	DI/CI/STL	CU	CU/PVC
1/2	7	3/8	5	3/8

3/4	7	3/8	5	3/8
1	7	3/8	6	3/8
1-1/4	7	3/8	7	3/8
1-1/2	9	3/8	8	3/8
2	10	3/8	8	3/8
2-1/2	11	1/2	9	1/2
3	12	1/2	10	1/2
3-1/2	13	1/2	11	1/2
4	14	5/8	12	1/2
5	16	5/8	13	1/2
6	17	3/4	14	5/8
8	19	3/4	16	3/4
10	22*	7/8	18	3/4

*Maximum spacing for insulated pipe shall be 20 feet.

- a. An additional hanger shall be installed at every change in direction of piping.
 - b. Cast-iron and ductile iron pipe shall have minimum one hanger per section close to each joint and at branch connections.
 - c. Plastic pipe shall have hangers spaced in accordance with manufacturer's recommendations.
4. When trapeze hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels or Unistrut for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes shall be based on the supported weight and load carrying capacity of attachment device.
 5. Horizontal pipe supports shall be:
 - a. Spaced as specified in MSS SP-58.
 - b. Installed $\leq 1'$ from the pipe fitting joint, at each change in pipe direction.
 - c. $\leq 5'$ apart at valves.
 - d. Pipe hanger loads ≥ 50 lbs, suspended from steel joists, shall have the hanger loads suspended from panel points.
 - e. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
 6. Vertical pipe shall be supported at each floor with riser clamps, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
 7. Piping shall not be supported from joist bridging or a roof metal deck.
 8. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.
 9. Piping at all equipment shall be supported to prevent strains or distortions in the connected equipment. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed. Unions shall be installed at the connection to all equipment and at valves, strainers, traps, etc.

10. Domestic water pipes which are subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.

D. Interior Waste, Soil, Vent and Storm Piping

1. The arrangement of the system shall be as shown on the drawings, and as direct as possible avoiding all unnecessary offsets.
2. Supporting of horizontal and vertical pipe shall be as hereinbefore described under "Installation of Piping".
3. Horizontal soil and waste pipes 4" and larger shall be given a minimum slope of 1/8" per foot, and pipes 3" and smaller shall be given a pitch of 1/4" per foot. All main vertical soil and waste stacks shall be installed with provision for expansion and shall be extended full size to and above the roof line as vents, except where otherwise specifically indicated.
4. Horizontal oil or grease waste piping shall be given a minimum slope of 1/4" per foot.
5. Where practical, two or more vent pipes shall be connected together and extended as one pipe through the roof. Where the Contractor makes changes of vent connections other than that indicated, he shall keep a record of the change. Vent pipes shall be run with horizontal piping pitched down to stacks without forming traps in pipes using fittings as required. Where an end of circuit vent pipe from any fixtures or line of fixtures are connected to a vent pipe serving other fixtures, the connection shall be at least 6" above the flood rim of the highest fixture above the floor on which the fixture is located.
6. All pipe shall be carefully handled and protected from damage. Damaged pipe shall not be installed.
7. All open drains shall be covered and protected during construction from all construction debris for the entire construction schedule. Open drains listed but not limited to; floor drains, floor sinks, trench drains, showers, bathtubs, lavatories, sinks, toilets, mop basins drinking fountains.
8. Bedding for underground pipes shall be as specified in Section 220010.
9. All changes in pipe size on soil, waste and drain pipes shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of combo wye and 1/8 bend, wye, long sweep 1/4 bends, 1/6, 1/8 or 1/16 bends, except that sanitary tees may be used on vertical stacks, and short 1/4 bends or elbows may be used in soil and waste pipes where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.
10. Slip joints will be permitted only in trap seals or on the inlet side of the traps. Tucker or hub drainage fittings shall be used for making union connections wherever practicable in connection with dry vents.
11. Vent pipes shall be flashed. This Contractor shall furnish and install all flashing and counter-flashing. Flashing shall be 5 pound lead. Flashings in connection with cast-iron pipe vents will be extended up to top of vent and turned down into pipes or hubs minimum 1". For pipes through outside walls, turn flanges back into wall, flash, metal counterflash and seal.
12. Seal drains watertight to adjacent materials.

13. Each fixture and piece of equipment requiring connection to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double-trapped. Traps installed on hub and spigot pipe shall be cast-iron. Traps installed on threaded pipe shall be recessed drainage pattern.
14. The vent stack shall be connected to the soil stack below the lowest fixture and carried up, all individual vents being connected thereto, extending through the roof.
15. Vents extending through the roof shall be a minimum of 25' from any supply fan or fresh air intake. If necessary, the vent shall be offset to meet this requirement. Check location of air intakes on equipment on roof prior to installation of vents.
16. Double wye soil, waste and storm pipe fittings are not allowed to be installed horizontally.
17. Wrap all pipe routed through concrete with polyethylene pipe guard before pour to de-couple pipe from concrete.

E. Cleanouts and Test Tees

1. Cleanouts shall be provided at the following locations:
 - a. Bottom of each exposed fixture trap not integral with the fixture.
 - b. At the foot of each soil and storm water stack.
 - c. At intervals not exceeding 50' for 4" sewer pipes and smaller, and not exceeding 100' for 5" sewer pipe and larger.
 - d. Miscellaneous locations as shown on the plans.
 - e. Where required by code.
2. Cleanouts shall be the same size as the pipe except cleanout plugs larger than 4" will not be required. Cleanouts installed in connection with cast-iron hub and spigot pipe shall consist of a long sweep 1/4 bend or one or two 1/8 bends extended to an easily accessible place, or where indicated on the drawings. An extra heavy cast-iron ferrule with screw cap plug shall be caulked into the hub of the fitting. Where cleanouts in connection with threaded pipe are indicated and are accessible, they shall be cast-iron drainage T-pattern 90° branch fittings or Y-branch fittings with screw plugs of the same size as the pipe up to and including 4". Test tees with cleanout plugs shall be installed at the foot of all soil, waste, and drain and roof drainage stacks and on each building drain outside the building.
3. Wall Access Cover Plate: Round, flat, chrome-plated brass or stainless-steel cover plate with screw. Deep, chrome-plated bronze type may be used where a flat type does not fit.

F. Joints

1. Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees shall not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

2. Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.
3. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
4. Brazed joints shall be made in conformance with AWS B2.2 with flux and are acceptable for line sizes. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
 - a. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
 - b. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.
 - c. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
5. Soldered joints shall be made with flux and are only acceptable for pipes 2 inches and smaller. Soldered joints shall conform to ASME B31.5.
6. Copper Tube Extracted Tee Joints shall not be allowed.
7. Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.
8. Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.
9. The tube or fittings for copper piping shall not be annealed when making connections.
10. Joints connecting pipe of differing materials shall be made with transition fittings approved by the pipe manufacturer and in accordance with the manufacturer's recommendation as approved by the Engineer.

G. Backup Plates

1. Where hot, cold and waste piping penetrates chase walls for connections to fixtures, this Contractor shall furnish and install backup plates. Backup plates shall span between and shall be firmly attached to the studs on either side of the fixture. Backup plate shall not be less than 3/4" plywood and shall be attached to the metal stud flange with at least three screws on each end. Holes through the backup plates for pipe penetrations shall be accurately drilled to pipe size to provide a close fit with the pipe. Piping shall be secured to the backup plate.

H. Escutcheons

1. Chrome plated escutcheons shall be provided at all locations where pipes penetrate walls in exposed locations.

I. Piping Insulation

1. Installation of the material shall comply with the manufacturer's recommendations.
2. Piping insulation and jacketing shall be applied in accordance with latest addition of MICA (Midwest Insulation Contractors Association). Insulation and Jacketing shall be applied with MICA Plate requirements. Insulation at hangers shall be applied in accordance with MICA Plate requirements. Insulation for fittings, valves, flanges, and couplings shall be installed in accordance with MICA Plates.
3. Unions, flanges, valves and other similar fittings shall be insulated except insulation may be omitted on unions for hot water piping.
4. Prior to application of insulation, piping and equipment shall have been tested. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.
5. All pipes with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete.
6. Where insulated piping is supported by hangers clamped directly to the pipe, the insulation shall be carefully fitted around hanger clamp and sealed at openings in jacket.
7. All fittings, flanges, valves, instruments, hanger rods and clamps shall be insulated with molded or mitered insulation or built-up insulation to a thickness equal to that of the insulation of the adjoining pipe, securely adhered and wired in place. For cold services (fluid temperatures less than 75°F) paint insulation with a vapor-barrier mastic. Fittings shall be covered with preformed fitting covers. Aluminum fitting covers are equally acceptable. For cold services, wrap the end joint with pressure sensitive joint tape furnished by the insulation manufacturer.
8. At pipe hangers, pipe hanger insulation inserts the same thickness as the insulation to prevent crushing the insulation.
9. Insulate Piping as follows:

a.	Application	Insulation Type	Wall Thickness
	CW & NP up to 1-1/2"	1	½"
		2	½"
	CW & NP over 1-1/2"	1	1"
	HW, TW & HWR up to 1 1/2"	1	1"
		2	1"
	HW, TW & HWR over 1 1/2"	1	1 1/2"
	Storm (ST & OD) (horizontal piping only)		

up to 5"	1	1/2"
	2	1/2"
6" to 24"	1	1"

Indirect waste pipes from Kitchen equipment (ice bins, refrigerator drains, etc.) or as noted on plans.

1	1"
2	1"

Indirect waste pipes from air handling equipment.

1	1"
2	1"

Drinking fountain chilled water pipes.

1	1-1/2"
2	1-1/2"

b. The following equipment shall be insulated with 1" thick Type 1 insulation:

- 1) All roof drain bodies.
- 2) Hot water storage tanks.

3.3 PLUMBING SYSTEMS TESTING

- A. It shall be the responsibility of this Contractor to test, and to place all equipment, piping, materials, etc., installed by him into proper and unattended operation.
- B. Piping systems shall be tested as hereinafter described. Piping or equipment not installed by this Contractor shall not be subject to tests. Existing piping or piping which is the property of utility companies shall not be subject to tests.
- C. All plumbing tests shall be made in the presence of the local Plumbing Inspector and Owner's representative unless approved otherwise by the engineer. Testing procedure shall conform to the regulations and codes of the local agency. All pipework shall be tested for leaks, cracked pipes, cracked fittings. All openings shall be capped or plugged, the pipework filled with water, and the installation proven tight before insulation and furrings are applied.
- D. Piping systems shall be tested in ambient temperatures of 40°F or higher.
- E. Testing of Soil, Waste and Vent Piping
 1. All underground soil, waste and vent piping shall be tested with water. The water shall maintain a constant level at the highest point or at least 10' above the mean elevation of the piping under test for at least one (1) hour. If leaks appear, lines shall be drained, leaks repaired and test repeated. No piping shall be concealed in any manner before being tested and approved.
 2. If local code is more stringent than the above test, then all soil, waste and vent piping shall be tested in accordance with local code.

F. Water System Testing

1. All water piping shall be tested with water at 100 psi or 1-1/2 times the maximum working pressure, whichever is greater. Pressure shall be maintained for a period of one hour. If leaks appear, pipes shall be drained, leaks repaired, and test repeated. No piping shall be concealed in any manner before tests are approved.
2. All domestic systems shall be disinfected in accordance with procedures described in AWWA Standard for Disinfecting for Building Potable Water Plumbing in New or Repaired Systems, AWWA November 2024, and in accordance with applicable local codes. The system shall be flushed prior to chlorination as thoroughly as possible. Clean all faucets strainers and shower heads. A velocity in the system of at least 2.5 fps should be developed. Chlorine shall be added to the system at the meter at a rate sufficient to produce a chlorine concentration of 50 mg/l available chlorine and held in the system for a 24-hour retention period. After chlorination, the system shall be flushed until the chlorine residual is 1.0 ppm at all faucets and shower heads. Testing for domestic systems shall be in accordance with ASHRAE 188-2018.

END OF SECTION 220400

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SECTION 230000 – MECHANICAL GENERAL CONDITIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 230000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The mechanical work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "Contractor" as used in these specifications shall mean the person, firm or corporation contracting to do the described work.
- E. It shall be a part of this Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.
- F. Rough-in for and connect, as shown on the drawings, facilities for equipment furnished by the Owner under a separate contract.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes adopted by the University of Missouri Health Care.

International Building Code - 2024
National Electrical Code - 2023
International Mechanical Code - 2024
International Fuel Gas Code - 2024
International Energy Code - 2018
International Plumbing Code - 2024
International Fire Code - 2024
International Existing Building Code - 2024

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, site, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Ductwork, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all duct, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as curbs and sealing, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to ensure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.

- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE

- A. This Contractor, before submitting bid, shall visit the site and become thoroughly acquainted with conditions under which the work will be performed.
- B. Failure to become fully acquainted with existing site conditions under which the work is to be performed will not be justification for additional compensation after the award of the contract.

1.7 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.8 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.
- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to:

SSC Engineering
Attention: Submittals
18207 Edison Ave.
Chesterfield, MO 63005
 - 4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".

- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the Contractor marked accordingly.
- E. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- F. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- G. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- H. Shop drawings shall include the plan mark used on the plans.
- I. Valve and fitting shop drawings shall indicate the intended service.
- J. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- K. Submittals which do not provide the required information will be returned unchecked.
- L. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- M. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.
- N. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.9 RELEASE OF CAD FILES

- A. See "Release of CAD Files" at the end of this section.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Include a Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 2. Complete set of shop drawings.
 - 3. Copies of all submittals.
 - 4. Parts lists, wiring diagrams, piping diagrams, etc.
 - 5. Manufacturers' operating and maintenance instructions.
 - 6. As-built drawings.
 - 7. Written operating and maintenance instructions for the system. This is a written version of Paragraph "1" above.
 - 8. Copies of warranties.
 - 9. Parts lists for each piece of equipment and name of local supplier.

1.11 AS-BUILT RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of piping, ductwork and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 GUARANTEE AND WARRANTY

- A. This Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year in accordance with the General Conditions. This one-year warranty shall commence on satisfactory completion of final punch list items. Satisfactory completion of the final punch list will be determined by the Engineer. If the Owner accepts a portion(s) of the project earlier than the rest, such as partial beneficial occupancy, that portion's warranty shall begin on the date it is accepted as substantially complete. A project may have multiple warranty periods in these certain cases and will be fully coordinated between the Owner, the Architect and the Engineer.
- B. During the guarantee period, this Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
 - 1. For manufacturers other than those listed, the Contractor shall prepare and submit to the Architect/Engineer for review, a proposal to provide a substitution. Proposal shall be submitted minimum ten (10) working days before the bid date and written approval shall be received from the Architect/Engineer before including the substitution in the bid. Substantiate that the substitution complies with the intent of the Project Documents and include sufficient information of the changes required so that a judgment may be rendered.
 - 2. Proposal shall include a drawing originated by the Contractor. The design shall show the intended installation to the same level of detail as that of the original design in addition to catalog cut, assembly manual, or other generic documents printed by the manufacturer or their representative.
 - 3. Prior to submitting the proposal, the Contractor shall notify all other contractors whose work is affected and request details and pricing of their respective changes. This information along with the Contractor's details shall be transmitted to the Architect/Engineer for approval.
 - 4. If the proposal is accepted, the Contractor shall compensate other trades which are affected by said proposal.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this Contractor's bid. This contractor shall be responsible for any and all engineering and

installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.

- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall provide all material, equipment, labor, services, and supplies, required to execute all work shown on the mechanical drawings; described in these specifications; or made necessary by the work shown on the drawings and/or described in these specifications.
- B. Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall provide power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be provided by the Temperature Control Contractor. Unless noted otherwise, the control wiring shall be provided by the Contractor furnishing the controlled equipment.
- F. Unless noted otherwise, the Electrical Contractor shall provide all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a

part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starters factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starters factory pre-wired with equipment such as chillers and packaged air conditioners) shall be provided by the Electrical Contractor. Magnetic motor starters will be provided with:

1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.
- G. Each Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized heater elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, thermal wells for temperature control system sensors shall be provided by the Temperature Control Contractor and installed by the Mechanical Contractor.
- I. Unless specifically noted otherwise, control valves and control dampers shall be furnished by the Temperature Control Contractor and installed by the Mechanical Contractor.
- J. Electrical Work For Mechanical Equipment: Electrical Contractor shall wire all mechanical equipment furnished by various contractors in accordance with the following general provisions:
1. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer's wiring diagram.
 2. Receive, unload, set and align all separately shipped motors. Adjust and align drive and adjust belt tension.
 3. Field lubricate all motors prior to initial operation of same.
 4. Install individual motor starters specifically called for to be furnished by other Contractors when not a factory pre-wired component.
- K. HVAC Contractor shall provide the following:
1. All motors, disconnect switches or control devices specifically called for.
 2. Automatic control and interlock wiring diagrams as called for in the specifications.
 3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
 4. Adjustable motor bases and all bolts and nuts required for installation of base and motor.
 5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This Contractor shall cooperate with and coordinate to plan and schedule the work to satisfy the schedule.
- B. All work shall be so arranged that electrical power, sewer, water, and other services are available to the building at all times, except for short periods of interruption necessary for the performance of new work. Interruptions shall not be requested until the new services are complete and ready for final connection.
- C. All interruptions shall be scheduled and services shall not be interrupted without written approval of the Owner's Representative. Notification to the Owner's Representative shall include the exact time and estimated duration of any interruption.

3.5 DEMOLITION OF FACILITIES

A. General

- 1. The demolition work shall consist of removal and/or relocation of mechanical equipment, ductwork, and related piping pertaining to the installation and modifications of the heating, ventilating and air conditioning systems as indicated on the drawings.
 - a. Piping to Be Removed: Drain piping and remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Ducts to Be Removed: Remove portion of ducts indicated to be removed to an existing joint in the duct, unless otherwise indicated, and cap remaining ducts with same or compatible ductwork material or cap with polyethylene film sealed to duct with duct tape.
 - d. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - e. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- 2. Contractor shall note the project is a renovation to an existing building. The building shall remain in operation at all times during the construction. Contractor shall allow adequate overtime and supervision to allow for work that is required by the owner to be performed after normal operating hours.

3. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. The Contractor shall be responsible to field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
4. Contractor shall review the drawings, specifications and existing job conditions and shall include in his bid all demolition work as required and as shown on the mechanical drawings.
5. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
6. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.

B. Existing Conditions

1. Contractor shall exercise great caution when performing demolition work to prevent damage to existing systems or items of work that are to remain. If Contractor damages, removes or destroys an existing system which is to remain, Contractor shall repair or replace that system to its original condition.
2. Unless specifically stated otherwise on the plans, where access to mechanical, plumbing, and fire protection items is required, Contractor shall provide the required access by removing ceilings, cutting openings, etc., as required. Prior to cutting openings, this Contractor shall outline the openings and shall obtain approval from and shall cut openings in the manner directed by the General Contractor. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.
3. Repair of openings is a part of this Contractor's work. Work shall be performed by the proper trades. Materials which are removed, damaged, or soiled shall be replaced with new materials. Ceilings and walls shall be repaired and restored to as close to the original condition as possible. This shall include replacement of surface finish materials such as paint, plaster, drywall, ceiling tile, etc.
4. Areas shall be repaired with materials matching those which have been removed.
5. Contractor shall repair streets, sidewalks, parking lots and reseed grassed areas which have been altered by his work.

C. Protection

1. During demolition operations, all persons and property shall be protected. This Contractor shall be responsible for the erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.

2. Contractor shall minimize any spread of dust, debris and flying particles. Demolition shall not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, this Contractor shall provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. Disposition of Material

1. Those items of material and equipment to be removed by this Contractor and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner.
2. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

3.6 MAINTENANCE OF WORK AREAS

- A. During the project, this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.
- B. Open ends of pipe, ductwork, equipment, and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.7 CLEANING AND CLEANUP

- A. Upon completion of this work, the Contractor shall clean all pipe, ductwork, fixtures, and equipment. Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. Each contractor shall be responsible for his own cleanup to a central location designated by the General Contractor. Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work.

END OF SECTION 230000

RELEASE OF CAD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2023. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CAD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 230010 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section covers basic mechanical materials and methods for the systems listed below and applies to work of those sections. Provide Basic Mechanical Material and Methods as indicated and required.
 - 1. Mechanical

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.

PART 2 - PRODUCTS

2.1 PRODUCT CRITERIA

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials

SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation
IEEE	Institute of Electrical and Electronic Engineers
AWWA	American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED PIPE SEALS

A. Seals for Floor or Foundation Wall Penetrations

- 1. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

2.4 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.6 SLEEVES

A. Exterior And Foundation Walls:

- 1. All piping through exterior walls, new concrete walls, or new foundation walls shall pass through sleeves which shall be large enough to allow for caulking and sealant materials.

No sleeves shall be permitted through concrete structural members unless indicated on the structural drawings or approved by the Structural Engineer. Sleeves shall be cut smooth and flush with each side of the wall.

- a. Sleeves above grade shall be Schedule 40 PVC pipe.
 - b. Sleeves below grade shall be cast iron or Schedule 40 PVC pipe.
2. All piping passing through existing concrete or foundation walls shall pass through core drilled holes which shall be large enough to allow for caulking material.
 3. All duct openings through exterior walls shall be sleeved with 20 gage galvanized steel sheet metal with flanges turned away from the opening on both sides unless otherwise indicated on the drawings. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.

B. Interior Walls And Partitions:

1. Fire Rated Walls:
 - a. Piping through fire rated interior walls and partitions shall pass through either Schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves (18 gauge sheet metal sleeves shall be installed if required by the U.L. classification). Schedule 40 steel pipe sleeves shall be used when required for structural purposes. Sleeves are not required for automatic control tubing.
 - b. Duct through fire rated interior walls and partitions shall be connected to sleeves with fire dampers. See section 230900, Air Distribution.
2. Non Rated Partitions:
 - a. Concealed Locations: Sleeves are not required for piping or ducts unless otherwise indicated on the drawings.
 - b. Visible Locations except in boiler, utility, or equipment rooms:
 - 1) Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon over the opening.
 - 2) Openings between pipes and wall shall be covered with escutcheons. Where required, special deep-type escutcheons shall be used. Escutcheons shall be chrome plated, one-piece or split-pattern, and secured in place.
3. Mechanical Room Walls and other locations indicated on the drawings: Duct openings shall be sleeved with 22 gauge galvanized steel sheet metal with flanges turned away from the opening on both sides. Space between sleeve and duct shall be packed with fiberglass and sealed on both sides.

2.7 BACKING & SEALANTS

- A. Backing and sealant for piping and ducts passing through floors, plaster ceilings, partition, and walls shall be as follows:

1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
2. Sealant: Gun Grade. A 1-part neutral- and basic-curing Silicone sealant, "790" by Dow Corning Corporation; "Spectrem 1 (Basic)" by Tremco, or SilPruf LM SCS2700 by GE Silicones.
3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following: 1) "SpecSeal" by Specified Technologies Inc. 2) 3M, 3) Chase Technology Corporation, 4) Link-Seal, 5) Pyro-Pac by Thunderline Corporation, 6) "Fyre Seal" by Tremco, 7) Pensil 100 by General Electric, 8) Pensil by STI, or 9) "Flameseal" by G. S. Nelson Electric.
 - a. Acrylic 1-part silicone rubber, gun applied, fire retardant elastic sealant, "Fyre Seal" by Tremco.
 - b. Silicon foam sealant, CTC PR-855 by Chase Technology Corporation.
 - c. Fire stop putty. "Flameseal" by G. S. Nelson Electric.
 - d. Intumescence Sealant (SpecSeal SSS100) shall be one-part, two stage intumescent latex compound, expands a minimum of 8 times when exposed to 230°F to >1000°F, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, red in color, and safe for contact with plastics.
 - e. Flexible Sealant (SpecSeal LC150) shall be one-part, latex-based compound, flexible and non-shrinking when dry, thixotropic. Sealant shall be capable of caulking or troweling on to vertical surfaces or overhead. Sealant shall be water-based, sandable, paintable, blue in color, and safe for contact with plastics.
 - f. Flexible Silicone Sealant (SpecSeal Pensil 300) shall be one-part, neutral curing silicone, completely water resistant, contain no solvents nor inorganic fibers, allow movement of +/-50%. Sealant shall be auto-bonding, ozone and UV resistant, chemical resistant and capable of caulking or troweling on to vertical surfaces or overhead.

- g. Intumescence Putty (SpecSeal Firestop Putty) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- h. Putty Pads (SpecSeal Firestop Putty Pads) shall be one-part, two stage intumescent, non-hardening compound, expands a minimum of 5 times when exposed to 230°F to >1000°F. Putty shall be soft and pliable with aggressive adhesion, contain no water-soluble intumescent ingredients, water-based, sandable, paintable, red in color, and safe for contact with plastics.
- i. Pillows (SpecSeal Firestop Pillows) shall be an intumescent pillow heat sealed in a fire-retardant poly bag with a monolithic core encapsulated by flexible intumescent coating and shall expand when exposed to 230°F to >1000°F.
- j. Mortar (SpecSeal Firestop Mortar) shall be light weight, fast drying, portland cement based, wet mortar density shall be ≤ 52 lb./cu.ft., dry mortar density shall be ≤ 45 lb./cu.ft., approved for combustible and noncombustible penetrants, have chemical adhesion, and be red in color.
- k. Silicone Foam (SpecSeal Pensil Silicone Foam) shall be two-part, silicone, room temperature curing foam, completely water resistant, contain no solvents nor inorganic fibers, allow movement of expansion, contraction and vibration.
- l. Intumescent Collars (SpecSeal Firestop Collar) shall be factory assembled collar utilizing a molded two stage flexible intumescent insert, insert shall expand a minimum of 15 times when exposed to 230°F to >1000°F, suitable for CPVC, ABS, ABS Foam Core, and FRPP pipes.
- m. Intumescent Wrap Strips
 - 1) (SpecSeal Firestop Red Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 15 times when exposed to 230°F to >1000°F.
 - 2) (SpecSeal Series Blu Wrap Strip) shall be highly flexible, two-stage intumescent material and shall expand a minimum of 30 times when exposed to 230°F to >1000°F.
- n. Intumescent coatings (SpecSeal Cable Coating) shall be water based, intumescent coating, expand a minimum of 5 times its dry applied thickness, flexible, water and weather-resistant film, contain no solvents or inorganic fibers. Coating shall be thixotropic and be capable of being applied by brush application or by airless spray.
- o. Urethane Joint Sealants
 - 1) Subject to compliance with requirements, provide one of the following:

- a) Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
- b) Polymeric Systems, Inc.; PSI-901.
- c) Approved equal.

5. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS Class 50, for Use NT.

2.8 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.9 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, boxes, panels, ducts, etc., shall be furnished and installed by the Contractor requiring the opening.
- B. Lintels furnished shall be ASTM A 36 structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.10 CUTTING

- A. Each Contractor shall be responsible for any cutting required for openings for conduits, pipes, ducts, etc., if sleeves or openings are not otherwise provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as glazed tile, wood paneling, etc., each contractor shall obtain the Owner's approval in advance of the cutting and patching.

2.11 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.
- C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.12 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be by Allen Systems, Inc., W.H. Brady Co.- Signmark Div., Industrial Safety Supply Co., Inc. or equal.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers with ½" high letters. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name, 2) Tag Number, and 3) Equipment Service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.13 UNDERGROUND PIPING MARKERS

- A. Tape: Triple-laminate, consisting of aluminum foil, polyester film, and polyethylene, 6" wide.
- B. Colored background, black lettering, two lines wide, and 2" tall letters. Provide different color tape for each piping service.
- C. Acceptable Manufacturer, subject to compliance with requirements: Panduit Corporation.

2.14 CEMENT GROUT

- A. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

2.15 CONCRETE

- A. Reinforcing Materials
 - 1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.

2. Welded Wire Mesh: Welded plain cold-drawn, ASTM A 185. Furnish in flat sheets, not rolls.

B. Concrete Materials

1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
3. Water: Potable.
4. Air-Entraining Admixture: ASTM C 260.
5. Water-Reducing Admixture: ASTM C 494, Type A.
6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
3. Design mixes to provide normal weight concrete with the following properties:
 - a. 4000 psi 28-day compressive strength.
 - b. 4,500 psi 28-day compressive strength at exterior locations where snow maintenance will be utilized.
4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:
 - a. Interior 2 - 4%.
 - b. Exterior 4.5 – 7.5%.
2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Slump Limits

1. Proportion and design mixes to result in concrete slump at point of placement at not less than 2" and not more than 4".

2.16 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall provide all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, ductwork, piping, etc. installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Provide concrete housekeeping pads a minimum of 3-½" high, unless detailed otherwise, under all equipment, pumps, etc., in equipment rooms that have piping containing water. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be ½" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.

3.2 PIPE AND DUCT PROTECTION DURING CONSTRUCTION

- A. Protect pipe and duct interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.3 DRIVE AND COUPLING GUARD

- A. Contractor shall provide coupling or belt guards on all drives which do not have guards factory installed. Belt guards shall enclose drive on all sides, shall have a hole for making tachometer readings, and shall comply with requirements of governing agencies including OSHA.

3.4 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. Contractor shall ascertain from his examination of the architectural and structural drawings and the facility whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary. The Contractor shall pay all costs of making such openings or providing such supports.

3.5 CUTTING AND PATCHING

- A. All cutting necessary for installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut. No openings shall be cut without written approval of the General Contractor.
- B. Before cutting or drilling holes in floors, verify the location of reinforcing steel bars and embedded electrical conduits to avoid cutting same. X ray floors where necessary to verify such locations. Contact the Engineer before proceeding with cutting if such obstructions interfere with the locations of planned holes.

3.6 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.7 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair. Provide access panels where indicated or required.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor whose equipment requires access shall provide access panels.
- C. Contractor shall obtain approval of Architect/Engineer of location of access panels that are not indicated on plans.

3.8 PAINTING

- A. All pieces of mechanical equipment shall be factory finished machinery-grey or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.

3.9 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves in foundation walls or footings shall be as detailed on the plans.
- C. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. If sleeves are shown on the plans or details, they shall be grouted in place.
- D. Where pipes and ducts pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.
- E. The internal diameter/dimensions of sleeves shall be 1" to 2" larger than the outside diameter/dimensions of the pipe, duct or insulation. Insulation shall be continuous through sleeves except for ducts with fire dampers. This space is sufficient to allow some movement of the pipes or ducts without cracking the sealant.
- F. The space between the pipes/ducts and the sleeve shall be sealed as follows:
 - 1. Exterior walls above grade: Caulking shall be applied to a minimum 3" total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½" in depth, finishing flush with the wall.
 - 2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer's instructions.
 - 3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3" recessed ½" below the finished floor or roof. This ½" recess shall then be filled with sealant to flush with finished floor or roof.
 - 4. Interior Non-Rated Walls/Partitions:
 - a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe or duct to 1" maximum. The space between the duct or pipe and the wall may be left open.
 - b. Visible Locations: Openings between duct and wall shall be covered with 24 gage galvanized steel sheet metal angles to form an escutcheon to cover the opening. Openings between pipes and wall shall be covered with chrome plated escutcheons.
 - 5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:

- a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc.) the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.
 - b. Where ducts pass through fire rated interior assemblies (walls, floors, ceilings, etc.) the ducts shall be connected to sleeves with fire dampers. See section 230900, Air Distribution and details on the drawings.
 - G. Shop drawings shall be submitted on all fire resistant materials and methods.
- 3.10 PIPING AND EQUIPMENT SYSTEMS MARKERS
- A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:
 - 1. Adjacent to each valve.
 - 2. At each branch or riser take-off.
 - 3. Where piping goes through floors, walls or ceilings.
 - 4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.
 - B. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.
 - C. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.
 - D. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and Plan Number and B) Equipment Service, matching terminology on schedules as closely as possible.
 - E. Install tape on top of all underground piping within 12" of grade. Locate markers as follows:
 - 1. Continuously over all underground pipes.
 - 2. Adjacent to each valve and fitting.
 - 3. At each take-off.
 - 4. At each pipe passage to underground.
- 3.11 LINES AND GRADES
- A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.

- B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.12 EXCAVATION

- A. Excavate, as necessary, for all underground piping as indicated on drawings and/or necessary.
- B. Material to be excavated shall be non-classified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.
- C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.
- D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed $4/3$ of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.
- E. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, and fittings. Remove projecting stones and sharp objects along trench subgrade.
- F. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.
- G. Grading in the area of the excavation shall be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- H. Where underground pipes cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Pipes which run parallel and at different levels shall be adequately separated to provide firm bedding for the pipes. Sewer, water and gas pipes shall be run in completely separate trenches, and at least three (3) feet apart at

center lines, except as approved by the Engineer. Whenever possible, water pipes shall be installed above sewer pipes and gas piping above water and sewer pipes.

3.13 BEDDING AND BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.
- B. Trenches for sewers, piping, etc., shall be backfilled for a depth of at least six (6) inches over the top of pipe with sand. Bedding shall be provided in the form of six (6) inches of sand under the pipes. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 0'-6" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 0'-6" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, recompact, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 230010

SECTION 230020 – VIBRATION ISOLATION AND SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide vibration isolators and seismic restraints as indicated for each type of equipment and for piping and duct systems. This section applies to:

- 1. HVAC System

1.2 SCOPE OF WORK

- A. The following items of equipment shall have flexible pipe connectors installed at the piping connection to the items:
 - 1. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
- B. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution to produce reasonably uniform deflections.
- C. All isolators and isolation materials shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
- D. Vibration isolation and seismic control manufacturer shall have the following responsibilities:
 - 1. Determine vibration isolation and seismic restraint sizes and locations.
 - 2. Provide piping, and equipment isolation systems and seismic restraints as scheduled or specified.
 - 3. Provide installation instructions and drawings.
 - 4. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, project seismic requirements, or 0.5G minimum seismic acceleration applied at the equipment center of mass. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
- E. Friction from gravity loads shall not be considered resistance to seismic forces.
- F. All piping and ductwork shall be restrained per the latest revision of the SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Material and Methods.

1.4 REFERENCES

- A. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Third Edition, 2008.

1.5 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.6 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading (Wherever loads are indicated, they shall apply only to outdoor equipment.)
 - 1. Basic Wind Speed: 90 mph.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: IV.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- B. Seismic-Restraint Loading
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: See Schedule on drawings.
 - b. Component Response Modification Factor: See Schedule on drawings.
 - c. Component Amplification Factor: See Scheule on drawings.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 21.3%.
 - 4. Design Spectral Response Acceleration at 1-Second Period: 16.7%.
 - 5. Seismic Design Category: D.

1.7 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind (for outdoor equipment) forces required to select vibration isolators, seismic and wind (for outdoor equipment) restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 4. Seismic and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and/or wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

- d. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
 - C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
 - D. Welding certificates.
- 1.8 QUALITY ASSURANCE
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
 - B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the products indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Isolation Technology, Inc.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibration Eliminator Co., Inc.
 - 7. Vibration Isolation.
 - 8. Vibration Mountings & Controls, Inc.
 - 9. Vibro Acoustics
- B. Specification W: 3/4" thick waffle pad shall be made of standard neoprene and shall consist of 2" square modules separated by a thin web. Load distribution plate shall be used as required. Pads shall be Mason Type Super "W".

- C. Specification B: Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be Mason Type SLF.
- D. Specification E: Vibration hangers shall contain a steel spring with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be Mason Type 30.
- E. Specification RG: Resilient Pipe Guides. Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements. Guides shall be Mason Type VSG.
- F. Specification H: Double-deflection type, elastomeric hangers fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Hangers shall be Mason Type HD.

2.2 VIBRATION ISOLATORS BASES

- A. Specification J - Inertia Base: Rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. Base depth shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include concrete reinforcement consisting of minimum ½" bars welded in place on 6 inch centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Base shall be furnished with anchor bolts and steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations. Include height saving brackets in all mounting locations to maintain a 1 inch clearance below the base. Obtain anchor-bolt templates from supported equipment manufacturer. Bases shall be Mason Type K or BMK.
- B. Specification WSB - Steel Base: Factory-fabricated, welded, structural-steel bases and rails. Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps. Structural Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment. Factory-

welded steel brackets on frame to provide for anchor bolts and equipment support and for outrigger isolation mountings. Bases shall be Mason Type K or BMK.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
 - 10. Erico
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD or an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.
- D. Specification SB: Spring type isolators shall be free standing and laterally stable and complete with 1/4 inch neoprene acoustical friction pads or neoprene cup between the spring and the base plate. All mountings shall have leveling bolts. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections compressed spring height and solid spring height. A steel housing shall be included to resist motion due to earthquake loads. A minimum clearance of 1/4 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. The housing shall be out of contact during normal operations. Mountings used out of doors shall be hot dipped galvanized. Mounting shall be SSLFH or SLR as manufactured by Mason Industries, Inc.

E. Specification SC: Restraint Cables:

1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cables and Type SRC Seismic Rod Clamps.
2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 wide, in varying lengths and combinations to meet load capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.

G. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.

H. Specification SAB: Seismic Anchor Bolts.

1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.4 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Resilient material shall be oil- and water-resistant standard neoprene.

- B. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- C. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.
- D. Curbs shall be Mason Industries Type SRSC.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION ISOLATORS

- A. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

- D. Install inertia base frames on isolator units as indicated to provide a minimum of 1 inch clearance when frame is filled with concrete and supported equipment has been installed and loaded for operation. Provide 3,000 psi concrete per section 230010 in accordance with manufacturer's instruction to fill base.
- E. The isolation type scheduled shall be provided for each type of equipment. (Isolators identified as "With Equipment" shall be furnished as an accessory with the equipment and shall be installed by the equipment manufacturer such as for internally isolated air handlers.)

3.4 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 230010 for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 for piping
 - 2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
 - 3. Brace a change of direction as indicated on the drawings or the local building code.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 percent. Single sided "C" beam clamps shall not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.
- F. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
- G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

- H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- I. Attachment to Structure: Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- J. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 230110 "Hydronic Piping" for piping flexible connections.

3.6 ADJUSTING

- A. Adjust isolators on piping after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. See schedule on plans.

END OF SECTION 230020

SECTION 230100 – INSTALLATION OF MECHANICAL PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, material, services and related items for the HVAC water systems shown on the plans and/or specified herein. These systems shall include:
 - 1. Hot / Chilled Water Dual Temperature
 - 2. Condensate Drains
 - 3. Refrigerant Piping
 - 4. Heating Hot Water

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.
- E. Section 230110 - HVAC Water Systems Piping.
- F. Section 230200 - Mechanical Insulation.
- G. Section 230930 - Testing and Balancing.
- H. Section 230960 - Temperature Controls.

1.3 REFERENCES

- A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- B. ANSI/ASME 31.9 - Building Services Piping.
- C. MSS SP-58-2009. Manufacturers Standardization Society Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.

1.4 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME Sec 9.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.5 SUBMITTALS

- A. Submit the following in accordance with Section 230000.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support. Indicate which piping systems each component will be applied to.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 except as modified herein.
 1. Hangers: Types 5 and 12 shall not be used.
 2. Hangers: Type 3 shall not be used on insulated piping.
 3. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 4. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
 5. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.
- B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.
- C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the above specification. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.
- D. Saddles and hangers for insulated piping:
 1. Type 39 saddles shall be used on all insulated pipe 12 inches and larger when the temperature of the medium is above 60 degrees F. Type 39 saddles shall be welded to the pipe.
 2. Type 40 shields shall:
 - a. be used on all insulated pipes less than 12 inches.
 - b. be used on insulated pipes larger than 12 inches when the temperature of the medium is 60 degrees F or less.
 - c. have a wooden insert for pipes 2 inches and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or distorted. Insulation jacket shall be sealed at the insert to provide continuity of the vapor barrier.
 - 1) In lieu of the wooden blocks, this Contractor may provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.

- d. distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

GALVANIZED IRON		
PIPE SIZE (INCHES)	SADDLE LENGTH (INCHES)	GAUGE THICKNESS
1/2 to 4	12	16
6	18	16
8 and 10	24	14

- E. The hangers or supports for piping with vapor barriers shall be located outside the insulation and the vapor barrier must be left undisturbed for pipes 10 inches and smaller.
- F. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Unistrut or Grinnell are acceptable. (Grinnell numbers are shown in parentheses)
1. Clevis Hanger Fig. B 3100 or B3104 (260 or 65)
 2. Adjustable Swivel Ring Fig. B 3170 (9)
 3. Adjustable Swivel Roller Fig. B 3110 (181)
 4. Adjustable Roller Support Fig. B 3114 or Fig. B 3122 ((171 OR 177)
 5. Riser Clamp (Standard Duty) Fig. B 3373 (261)
 6. Riser Clamp (Heavy Duty) Fig. (40)
 7. Offset Clamp Fig. B 3148 (103)
 8. Wall Bracket (Light Duty) Fig. B 3068 (194)
 9. Wall Bracket (Medium Duty) Fig. B 3065 (195)
 10. Stand with Base Fig. B 3088 or Fig. B 3088T (62 OR 63)
 11. U-Bolts Fig. B 3188 (137)
 12. Structural Attachments:
 - Beam clamps: B 3031(92), B 3033(93), B 3034(94), B 3050(133), B 3045(217) and retaining straps for seismic applications
 - Angle Iron Beam Clamp: B 3046
 - Bar Joist: B 3059
 - Concrete Inserts: B 2500 (281), B 2505 or 2506(285), or B 3014(282)
 - Drilled Inserts: Phillips Red-head, wedge anchors

2.2 PREFABRICATED PIPE STANDS

- A. See Section 230010.

2.3 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. All pipe shall be run parallel to or at right angles to walls, beams or columns. Pipe shall be run as direct as possible, avoiding unnecessary offsets, and maintaining maximum headroom. Shortcut diagonal methods will not be allowed.
- B. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed. Provide reducers/increasers at connections to equipment as required to match the equipment. Pipe and fittings shall be installed so that all pipe and/or insulation completely clears all nearby structures and piping.
- C. All piping shall be supported from the building structures by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitch of lines, to prevent vibration and excessive deflections, and to secure piping in place.
- D. Piping shall be arranged to allow for expansion and contraction. Provide expansion loops, guides and anchors where indicated on the drawings.
- E. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line except branch take-offs shall be made with swing connections where required to avoid stress at these points. Tees shall not be installed in a bullhead arrangement.
- F. At swing connections, offsets, expansion loops, etc., pipes shall be cold sprung into place before welding to compensate for fifty percent (50%) of the expansion.
- G. Pipes shall not be hung from other piping or from equipment of other trades. Hanger rods and piping shall not pierce ductwork.
- H. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.
- I. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed.
- J. Install unions in pipes 2-1/2 inch and smaller at final connections to each piece of equipment and at valves, strainers, traps, etc., and elsewhere as indicated. Unions are not required on flanged devices. Install flanges on valves, apparatus, and equipment having 3 inch and larger connections.
- K. Dissimilar metals in the piping system shall be separated with dielectric unions or insulating flange sets.
- L. Provide plugged tees at all low points, except where drain valves are called for to allow for system drainage. All pipe lines shall be pitched to equipment traps and/or outlets. All

horizontal mains shall be graded to have a pitch of at least 1" in 40'-0" in the direction of flow unless otherwise noted. Eccentric couplings, pitched fittings, etc., shall be installed where necessary to eliminate pockets.

- M. Provide manual air vents at all high points to allow bleeding of air from the system. Where gauge cocks are shown at coils, etc., these gauge cocks may serve as the air vent at that location.
- N. Factory fabricated fittings, similar to Bonney Forge Weldolet, Threadolet, Socklolet, or Elbolet may be used for branch connections to mains where branch size is less than main's size.
- O. Welding shall be performed by individuals who are currently qualified under procedures certified as acceptable by the National Certified Pipe Welding Bureau. Individuals must be prepared to provide current qualification certificates upon request. All work shall be done in accordance with the latest revised edition of the ASME Code for Pressure Piping requirements.
- P. Lines subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.
- Q. Drain lines shall be terminated over floor drains to direct the flow vertically into the floor drain. Provide elbows where required. Cut openings in the floor drain strainer where needed to prevent splash-out. Provide clean outs at changes in direction of more than 45 degrees and at maximum 75 feet spacing along the line.

3.2 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.
 - 2. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.
 - 3. Heat joints using oxy-acetylene torch to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 - 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

- a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Welded Joints: Comply with the requirement in ASME Code B31.9-"Building Services Piping."
- E. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- F. Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions.
- G. Press-Joint Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B 16.22 and performance criteria of IAPMO PS 117. All copper press fittings, couplings and specialties shall be the products of a single manufacturer. Installation tools shall be as recommended by the fittings manufacturer.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments, complete with necessary inserts, bolts, rods, nuts, washers, and other accessories, to support piping from building structure; comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-58.
- B. Install building attachments within concrete or to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts. Where inserts are omitted, drill through concrete slab and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab in locations where nut, etc. will interfere with other work or be a tripping hazard and above slab in other locations.
- C. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe lines shall not be less than the following schedule:

(STL = Steel , CU = Copper)

PIPE SIZE (INCHES)	MAXIMUM HANGER SPACING (FEET)	MINIMUM ROD SIZE (INCHES)	MAXIMUM HANGER SPACING (FEET)	MINIMUM ROD SIZE (INCHES)
	STL	STL	CU	CU/PVC
1/2	7	3/8	5	3/8
3/4	7	3/8	5	3/8
1	7	3/8	6	3/8

1-1/4	7	3/8	7	3/8
1-1/2	9	3/8	8	3/8
2	10	3/8	8	3/8
2-1/2	11	1/2	9	1/2
3	12	1/2	10	1/2
3-1/2	13	1/2	11	1/2
4	14	5/8	12	1/2
5	16	5/8	13	1/2
6	17	3/4	14	5/8
8	19	3/4	16	3/4
10	22*	7/8	18	3/4
12	23*	7/8	19	3/4
14	25*	1		
16	27*	1		

*Maximum spacing for insulated pipe shall be 20 feet.

1. An additional hanger shall be installed at every change in direction of piping.
- D. When trapeze type hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels, Unistrut or tee sections for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes and spacing for trapeze hangers shall be based on supported weight and load carrying capacity of attachment device. Size trapeze bar for allowable loads indicated in SMACNA HVAC Duct Construction Manual (2005), Table 4-3, or as otherwise approved by the Engineer.
- E. Hanger rods shall have double nuts and lockwashers at all connections.
- F. Piping at walls shall be supported with wall brackets; vertical pipes shall be supported with riser clamps.
- G. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.
- H. Piping shall not be supported from joist bridging or a roof metal deck.
- I. Horizontal pipe supports shall be:
1. Spaced as specified in MSS SP-69.
 2. Installed $\leq 1'$ from the pipe fitting joint, at each change in pipe direction.
 3. $\leq 5'$ apart at valves.
 4. Pipe hanger loads ≥ 50 lbs, suspended from steel joists, shall have the hanger loads suspended from panel points.

- 5. Maximum of 4' on center for PVC piping. *Note: Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements.*
- 6. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
- J. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
- K. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.
- L. High Temperature Guides with Cradles: Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.
- 3.4 Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6-inch and larger shall be sheet metal. See additional requirements in Section 230010.
- 3.5 Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 230010 for sealants and materials.
- 3.6 Provide seismic bracing in accordance with Section 230020 and details shown on drawings for piping and specialties where indicated or required by the local building code.
- 3.7 Provide thermometers, thermometer sockets, and thermal wells where indicated on the drawings or in the specifications. Install in tees or in extra heavy nipples welded to the pipe or as indicated on the drawings. Install thermal wells for temperature control system temperature sensors (furnished under Section 230960 - Temperature Control Systems) and where indicated on the drawings. Coordinate the location of temperature sensor wells with the temperature control contractor and the Engineer.
- 3.8 Install control valves and pressure sensors in accordance with the manufacturer's instructions where indicated on the drawings or in the specifications. Install taps and shut off valves for pressure sensors for temperature control system sensors (furnished under Section 230960 - Temperature Controls) and where indicated on the drawings.
- 3.9 Provide pressure gauges and test plugs where indicated on the drawings or in the specifications.

3.10 Dielectric unions shall be provided at the following locations:

- A. At the connection of copper and steel piping.
- B. At the connection of steel piping to copper coils.

END OF SECTION 230100

SECTION 230110 – HVAC WATER SYSTEMS PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, material, services and related items for the HVAC water systems shown on the plans and/or specified herein. These systems shall include:
 - 1. Hot / Chilled Water Dual Temperature
 - 2. Condensate Drains
 - 3. Heating Hot Water
 - 4. Refrigerant Relief Piping

1.2 RELATED WORK

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.
- E. Section 230100 - Installation of Mechanical Piping.
- F. Section 230200 - Mechanical Insulation.

1.3 REFERENCES

- A. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- C. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- D. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- E. ASTM B88 - Seamless Copper Water Tube.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME 31.9.

1.5 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME Sec 9.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9.
- D. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Include data on pipe materials, pipe fittings, valves, specialties and accessories. Each submittal shall be clearly marked for the service(s) intended.
- C. Indicate seismic restraint locations including both lateral and transverse bracing on each shop drawings and described on product data. Indicate each restraint type as described on product data.

PART 2 - PRODUCTS

2.1 Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:

- A. Dielectric Waterway Fittings:
 - Victaulic Company of America
 - Approved equal
- B. Dielectric Unions:
 - Perfection Corp.
 - Watts Regulator Co.
- C. Dielectric Nipples:
 - Elster Perfection.
 - Grinnell Mechanical Products.
 - Matco-Norca, Inc.
 - Precision Plumbing Products, Inc.
 - Victaulic Company.
- D. Circuit Setter/Balancing Valves:
 - Bell & Gossett
 - Taco
 - Armstrong
 - Macon
- E. Auto Flow Control Valves:
 - Griswold
 - Bell & Gossett
 - Approved equal
- F. Ball Valves:
 - Nibco
 - Watts
 - Crane
 - Hammond
 - Stockham

James Bury
Gemini
Contramatics

G. Butterfly Valves, Swing check valves, and Spring check valves:

Nibco
Jenkins
Centerline
Crane
Demco
DeZurik
Keystone
Hammond
Stockham

GROOVED MECHANICAL JOINT:

Victaulic
Anvil (formerly Grinnell) Corp.
Nibco

H. Triple Duty Valves:

Bell & Gossett
Taco
Armstrong

I. Relief Valves:

Watts
Bell & Gossett
Taco
Armstrong

J. Pressure Regulating Valves:

Watts
Mueller
Stockholm

K. Y-Pattern Strainers:

Armstrong Machine Works
Keckley
Illinois
Muessco
Metraflex Co.
Nibco
Spirax Sarco.
Victaulic Co. of America
Anvil

- L. Basket Strainers:
 - Crane Co.
 - Keckley
 - Illinois
 - Muessco
 - Metraflex Co.
 - Spirax Sarco.
 - Victaulic Company of America
 - Anvil
- M. Wafer Type Flow Elements:
 - Bell & Gossett
 - Taco
- N. Automatic Air Vent:
 - Bell & Gossett, ITT
 - TACO, Inc.
 - Armstrong
- O. Flexible Connectors Type (1):
 - Flexonics
 - Anaconda
 - Metraflex
- P. Flexible Connectors Type (2):
 - Resistoflex
 - Thermo-Tech
 - Metraflex
 - Garlock
- Q. Thermometers:
 - Palmer
 - Trerice
 - Weiss
 - Jay
 - Marsh
 - Weksler
- R. Pressure Gages:
 - Marsh
 - Weiss
 - U.S. Gauge
 - Weksler
 - Trerice
- S. Test Plugs:
 - Universal Lancaster, Lancaster, Ohio

Peterson Equipment Co., Inc.
 MG Piping Products Co.
 Sisco, A Spedco, Inc. Co.
 Trerice (H.O.) Co.
 Watts Regulator Co.

- T. Expansion Joints:
 Flexonics
 Anaconda
 Adsko
 Metraflex

- U. Pipe Alignment Guides:
 Adsko
 Metraflex
 Anvil

2.2 All components, including pipe, fittings, valves, pumps, coils, heat exchangers, etc., used in the hot, chilled, condenser or make-up water systems shall be suitable for a continuous operating pressure of not less than 125 PSIG.

2.3 Schedule of pipe system materials for 2 pipe changeover dual temperature and VAV heating hot water system.

ITEM	2-1/2" AND UNDER SCREWED	3" AND OVER FLANGED AND WELDED
Pipe	Type (7)	Type (7) or (2)
Fittings	Type (7)	Type (8) or (2)
Unions and Flanges	Type (1)(150 lb)	Type (2)
Dielectric Unions	Type (7)	Type (9) or (7)
Dielectric Nipples	Type (10)	
Stop Valves	Type (5) or (9)	Type (5) or (9)
Check Valves	Type (4)	Type (6)
Joint Materials	Type (3) or (4)	Type (3) or (4) or (2)
Flange Bolts	Not Applicable	Type (1)
Y Type Strainers	Type (1) or (3)	Type (1) or (2) or (3)
Manual Air Vents	Type (1) or (2)	Type (1) or (2)
Automatic Air Vents	Type (3)	Type (3)
Manual Balancing Valves	Type (1)	Type (1)
Flexible Connector	Type (1)	Type (1)

2.4 Schedule of pipe materials for copper condensate drain piping.

<u>ITEM</u>	
Pipe	Type (8)
Fittings	Type (7) or Type (8)

2.5 Schedule of pipe materials for plastic condensate drain piping.

ITEM

Pipe	Type (3)
Fittings	Type (3) or Type (4)

2.6 Schedule of pipe materials for make-up water.

ITEM

Pipe	Type (7)
Fittings	Type (7) or Type (8)

2.7 PIPE

- A. Type (1) - Carbon steel pipe ASTM-A106 continuous weld electric-weld, or seamless Schedule 40, USAS B31.1.
- B. Type (2) - Carbon steel pipe ASTM-A53 Grade B, electric-welded or seamless, Schedule 40, USAS B-31.1.
- C. Type (7) - Type L hard drawn copper.
- D. Type (8) - Type DWV hard drawn copper.
- E. Type (3) - Poly-vinyl Chloride Pipe:
 - 1. PVC schedule 40 pipe with plain ends: ASTM D-2665.
 - 2. Solvent cement joints: ASTM D-2665.
- F. Type (4) - Chlorinated Poly-vinyl Chloride Pipe:
 - 1. CPVC Pipe: Schedule 40: ASTM F 441/F 441M

2.8 FITTINGS

- A. Type (1) - Malleable iron, screwed 150 lbs. Standards: ASA B16.3, threads ASA B2.1; material ASTM A-47 Grade 32510.
- B. Type (2) - Seamless carbon Steel Grade B standard weight butt-weld fittings, Standards: ASA B16.9; material ASTM A234.
- C. Type (3) - Poly-vinyl Chloride Fittings:
 - 1. Socket fittings, schedule 40: ASTM D-2665.
- D. Type (4) - Chlorinated Poly-vinyl Chloride Fittings:
 - 1. Fittings for CPVC Tubing:
 - a. CPVC Socket Fittings: Schedule 40. ASTM F 438

b. CPVC Threaded Fittings: Schedule 80. ASTM F 437

E. Type (7) - Wrought or cast bronze solder type fittings. T-drill fittings not acceptable.

2.9 UNION AND FLANGES

- A. Type (1) - Malleable iron unions, 150 lbs. Standards: Threads ASA B2.1; Material ASTM A-47, Grade 32510, ASA B16.3, Ground joint bronze-to-iron or bronze-to-bronze.
- B. Type (2) - Forged carbon steel flange weld neck type, bored to match Schedule 40, 150 lb. ASA-B16.5, raised face, materials ASTM A181, Grade 1.
- C. Type (7) - All bronze or brass, suitable for 150 psi working pressure.
- D. Type (8) - Dielectric union, malleable iron ASTM A197 or brass and bronze ASTM B-16 and ASTM B-844, or 250 psi ANSI B16.39, threaded ANSI B2.1. Watts 3000 Series.
- E. Type (9) - Dielectric flanges, iron rated for 125 psi ANSI B16.42, Watts 2200 series (iron pipe thread to iron pipe thread), or 3100 series (iron pipe thread to copper solder joint).
- F. Type (10) - Dielectric Nipples: Electroplated steel nipple. Complying with ASTM F 1545. Pressure Rating: 300 psig at 225 deg F. End Connections: Male threaded or grooved. Lining: Inert and noncorrosive, propylene. Standard: IAPMO PS 66.

2.10 JOINT MATERIAL OR GASKETS

- A. Type (1) - Thread sealing compound compatible with water, or teflon tape.
- B. Type (2) - Flanged joints, water, Garlock red rubber style 22, Manville or equal.
- C. Type (3) - Solder Joints: Joints shall be soldered with 95-5 solder using #50 petrolatur flux.
- D. Type (4) - Copper or Bronze Pressure-Seal-Joint Fittings: Fittings for NPS 4 and Smaller:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Viega
 - b. Nibco
 - c. Elkhart
 - 2. Housing: Copper
 - 3. O-Rings and Pipe Stops: EPDM
 - 4. Minimum 200 psi working pressure and 250 degree F. working temperature.
 - 5. Press-Joint Fittings: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B 16.22 and performance criteria of IAPMO PS 117. Fittings shall be designed such that sealing elements stays properly in its groove and does not roll out when inserting tube. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have a feature that

assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation. All copper press fittings, couplings and specialties shall be the products of a single manufacturer. Installation tools shall be as recommended by the fittings manufacturer.

- E. Type (5) - Solvent-Cemented Plastic Piping Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.

2.11 FLANGE BOLTS AND NUTS

- A. Type (1) - Carbon steel machine bolts ASTM A-307 Grade A, heavy series hex nuts ASTM A-194 Grade 1, ASAI B1.1 and B18.2.

2.12 VALVES – GENERAL

- A. Each valve shall be shell and seat tested by the manufacturer.
- B. All valves of the same type shall be of the same manufacture.
- C. Valves shall not contain asbestos.
- D. Operator features:
 - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 - 2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Plug valves shall have square heads; furnish one wrench for every 10 plug valves (minimum 3).
 - 3. Gear drive operators, on quarter-turn valves 8-inch and larger.
 - 4. Malleable iron chain wheel operator and chain for valves located more than 7 feet above the floor except for valves located above ceilings; provide chains for operation at 5 feet above floor.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Shop drawings shall be submitted on all valves. Each submittal shall be clearly marked for the service intended.
- G. Model numbers used for each type of valve shall establish the desired type, quality and materials of construction. Products equal to the valve specified and meeting these specifications, by the manufacturers listed above are equally acceptable.

2.13 STOP VALVES

- A. Type (4) - Nibco LD-2000, iron body butterfly valve, lug type, aluminum-bronze disc, stainless steel stem and disc screws, Buna N stem seals, EDPM replaceable seat, extended neck, infinite position lever handle with memory stop, comply with MSS-SP-67, suitable for dead end service at full pressure rating of valve. Valves above 6" NPS shall have a gear operator. 150 psi WP, 50 to 275°F.
- B. Type (5) - Nibco S-595-Y- 66, 3 pc. bronze ball valve, teflon seat and seals, full port, stainless steel ball and stem, solder ends, comply with MSS-SP-110. 600 psi WOG.
- C. Type (6) - Nibco T-585-70-66, 2 pc. bronze ball valve, teflon seats and seals, full port, stainless steel ball and stem, threaded ends, comply with MSS-SP-110. 150 psi steam, 600 psi WOG.
- D. Type (7) - Nibco GD-4765 or Victaulic Series 700/701, iron body butterfly valve, grooved type, aluminum-bronze disc, stainless steel stem and disc screws, Buna N stem seals, EDPM encapsulated disc, extended neck, infinite position lever handle with memory stop, comply with MSS-SP-67, suitable for dead end service at full pressure rating of valve. Valves above 6" NPS shall have a gear operator. 150 psi WP, 50 to 275°F.
- E. Type (9) - 2 pc., bronze ball valve, teflon seats and seals, full port, stainless steel ball and stem, press fit ends, comply with MSS-SP-110. 150 psi steam, 600 psi WOG. VALVES MUST HAVE A STAINLESS STEEL BALL AND STEM.
- F. Type (10) - Nibco PFD-2000, iron body butterfly valve, lug type, press x press female ends, aluminum-bronze disc, stainless steel stem and disc screws, EPDM stem seals, EDPM molded in seat, extended neck, infinite position lever handle with memory stop, comply with MSS-SP-67, suitable for dead end service at full pressure rating of valve. 2-1/2" to 4" NPS. 200 psi WP, 250°F maximum.

2.14 CHECK VALVES

- A. Type (1) - Nibco T-413-Y, bronze swing check, Class 125, ASTM B-62 body, TFE seat, threaded ends, comply with MSS-SP-80, 125 psi steam, 250 psi WOG.
- B. Type (4) - Nibco PF-413-Y, bronze swing check, Class 125, ASTM B-62 body, TFE seat, press fit ends, comply with MSS-SP-80, 125 psi steam, 250 psi WOG.
- C. Type (5) - Nibco S-413-Y, bronze swing check, Class 125, ASTM B-62 body, TFE seat, solder ends, comply with MSS-SP-80, 125 psi steam, 250 psi WOG.
- D. Type (6) - Nibco W910-W or W920-W, wafer type, ASTM A126 Class B or A48 iron body, bronze disc plates, rubber seat, comply with MSS-SP-71, non-asbestos gaskets, stainless steel hinge pins, stop pins and spring, suitable for continuous duty at 125 psi and 250°F.

2.15 RELIEF VALVES

- A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled. 150 PSIG WP. Relief pressure setting 30 to 150 psig as indicated on the plans. Watts model 174A or equal.

2.16 PRESSURE REGULATING VALVES

- A. Bronze body, screwed-end, adjustable outlet pressure, nitrile diaphragm and seat, stainless spring, capacities ASME certified and labeled, 200 psig inlet pressure maximum, 25 to 75 psig outlet, 150°F maximum fluid temperature. Diaphragm and seat material available for fluid temperatures to 250°F. Watts model N45 or equal.

2.17 Y TYPE STRAINERS

- A. Type (1) - Screwed end, iron body, 250 psi steam at 425°F., 400 psi water at 100°F., with blowoff outlet, stainless steel screen or Monel. Screen shall have 1/32" holes for water service. Muessco #11.
- B. Type (2) - Flanged, 125 lb. ASA flanges, iron body, 125 psi steam, 175 psi WOG with blowoff outlet, reinforced brass screen with 1/4" perforations for water. Muessco #751.
- C. Type (3) - Pressed fit end, bronze body, Class 125, 250°F max operating temperature., 200 psi WP., with plugged cap, 20 mesh stainless steel screen. Nibco PF221 or equal.

2.18 BASKET STRAINERS

- A. Type (2) - Flanged, 125 lb. ASA flanges, iron body, iron clamp and Buna N O-ring basket seal, 155 psi WOG with plugged drain outlet, stainless steel perforated basket with 5/32" perforations for water. Muessco # 155M.

2.19 DUPLEX BASKET STRAINERS

- A. Flanged, 125 lb. ASA flanges thru 5", 150 lb. ASA flanges 6" thru 16", iron body, iron clamp and Buna N O-ring basket seal, 150 psi WOG with plugged drain outlet, stainless steel perforated basket with 5/32" perforations for water. Muessco # 691.

2.20 AIR VENTS

- A. Type (1) - Manual air vents shall be equal to Dole, screw driver type.
- B. Type (2) - Manual air vents at pumps shall be 1/4" or 3/8" ball valves equal to Nibco T-569-BR-Y-20 one pc., bronze ball valve, teflon seats and seals, bronze ball and stem, threaded ends, comply with MSS-SP-110, 600 psi WOG.
- C. Type (3) - Automatic Air Vent: designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240 deg F operating temperature; and having 1/4 inch discharge connection and 1/2 inch inlet connection. Bell & Gossett Model 87 or equal.

2.21 BALANCE VALVES

A. Type (1)

1. Valves shall be calibrated bronze balance valves with provisions for connecting a portable differential pressure meter as shown on the plans.
2. Meter connections to have built-in check valves. An integral pointer shall register degree of valve opening. Each balance valve shall be constructed with internal seals to prevent leakage around rotating element, suitable for 100% shut-off.
3. Each balance valve shall be constructed for 150 pounds working pressure @ 250°F. and supplied with preformed polyurethane insulation.
4. Valves shall be as manufactured by Bell and Gossett, TACO, Nibco, Illinois or Armstrong.
5. Contractor shall furnish to Balancing Contractor a differential pressure meter equal to Bell & Gossett Model No. RO-4 for balancing of balance valves. Balancing Contractor shall give the meter to the Owner upon completion of water balancing.

2.22 AUTO FLOW CONTROL VALVES

A. Valves shall be brass and stainless steel with threaded connections and shall have the following features:

1. Performance certified by an independent laboratory.
2. Permanently marked to show direction of flow, flow rate and pressure range.
3. Pre-set to control the flow rate within 5% of the tagged rating.
4. Replaceable flow cartridges that allow field-exchange of internal components without removing the valve body from the pipeline.
5. Maximum of 5 feet of pressure drop.
6. Inline check valve and strainer.

B. Valve shall be sized to handle 110% of flow scheduled on drawings.

2.23 TRIPLE DUTY VALVES

A. Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Size valve to for 3 to 6 feet pressure differential with valve 100% open; reduce from line size if required.

2.24 FLOW MEASUREMENT

A. Wafer Type Flow Elements:

1. Type: Differential-pressure wafer type orifice insert flow elements designed for installation between pipe flanges. Pressure drop across the orifice shall not exceed 5 ft. H₂O of head on sizes over 1-1/2". Accuracy of the flow measuring elements shall be +/- 2.3% as verified by independent laboratory reports.
2. Construction: Cast iron body, brass valves with integral check valves and caps, and calibrated nameplate. Elements shall be pressure rated for 300 psig and 250°F.

3. Contractor shall furnish to Balancing Contractor a differential pressure meter equal to Bell & Gossett Model No. RO-4 for measuring flow at elements. Balancing Contractor shall give the meter to the Owner upon completion of water balancing. If an equivalent, suitable meter is furnished with the balancing valves, a separate meter is not required for the wafer flow elements.
4. Model: Bell and Gossett Circuit Sensor.

B. Annular Flow Element

1. Furnish and install, where shown or called for, an annular element Ellison Instrument Div., Dieterich Standard Corp., Boulder, Colorado.
2. Flow Element: Elements shall be either nipple section or weld insert type and be rated to 275 psi at 400°F. Annular measuring element shall be made of stainless steel. Each element shall be complete with shutoff valves and a permanent metal tag showing designed flow rates, meter readings for designed flow rates, metered fluid, line size and tag number. Permanent pressure loss to the system shall not exceed 5" H₂O (0.42 ft.) of head on sizes over 1-1/2". Accuracy of the flow measuring elements shall be + .55 to 2.3% as verified by independent laboratory reports.
3. This system shall consist of an annular primary element flow station. Each annular measuring station shall be complete with shutoff valves and a permanent metal tag showing designed flow rates, meter readings for designed flow rates, metered fluid, line size and tag, station or location number. Annular measuring element shall be made of stainless steel. Stations shall be either nipple section or weld insert type and be rated to 275 psi at 400°F. Permanent pressure loss to the system shall not exceed 5" H₂O (0.42 ft.) of head on sizes over 1-1/2". Accuracy of the flow measuring elements shall be + .55 to 2.3% as verified by independent laboratory reports.
4. Meters shall be "Eagle Eye", by Ellison instrument division. Meters shall be accurate to within + 1.8% of full scale for pipes to 5" in size, and to within + 2.2% for pipes over 5". Meters shall include zero adjustment, pulsation dampening and internal equalizing system. Wetted metal components shall be 316 stainless steel. One meter capable of reading all flow elements shall be furnished to the Owner. Meter shall be portable and shall include carrying case and flexible hoses for connecting to the flow elements.

2.25 EXPANSION SYSTEM

A. Type (1)

1. Furnish and install in each closed water system an expansion system to allow for the volumetric expansion of the fluid.
2. Expansion tanks shall be captive air, pre-pressurized, diaphragm type. Tank shall be suitable for a maximum working pressure of 125 psi and shall be constructed and certified to ASME Section VIII. Diaphragm shall be suitable for a maximum operating temperature of 240°F and shall be constructed of heavy duty Butyl or equal. Expansion tanks shall be suitable for vertical or horizontal arrangement as indicated in the

schedule. Provide taps for pressure gage and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles.

3. Air separators 2" and larger shall be tangential, cyclonic, welded black steel. Air separators shall utilize vortex flow pattern to create a low pressure zone for releasing air bubbles. Air separators shall be ASME constructed and shall be stamped for 150 psi working pressure. Units shall include flanged inlet and outlet, air release outlet, and bottom blowdown connection. Units shall include a stainless steel, removable strainer only if indicated on the drawings.
4. Air separators 1-1/2" and smaller shall be the reduced velocity, air scoop type. Air separators shall be suitable for 125 psi working pressure. Units shall include threaded inlet and outlet, air release outlet, and bottom blowdown connection. Units shall include a stainless steel, removable strainer only if indicated on the drawings.
5. Expansion system shall include an automatic air eliminator. Armstrong model 720 or approved equal.
6. Expansion system shall include the following make-up water valves and specialties:
 - a. ASME pressure relief valve
 - b. Pressure reducing valve
 - c. Strainer
 - d. Check valve
 - e. Stop valves and both sides of strainer and pressure reducing valve
 - f. Bypass valve
7. Relief valve, pressure reducing valve, strainer, check valve, stop valve and bypass valves shall comply with valve specifications for HVAC water systems.

2.26 FLEXIBLE PIPE CONNECTORS

A. Type (1)

1. Metraflex metal braided, bellows type, screwed or flanged, 150 psi working pressure at the maximum service temperature (up to 250°F). Length shall allow for 3/8" misalignment.
 - a. Model BBS, bronze hose and braid up through 2"
 - b. Model SLP, stainless steel hose and braid over 2"

B. Type (2)

1. Resistoflex Model R6904 with bellows molded from DuPont T.F.E. teflon. Connectors shall be equipped with monel reinforcing rings, ductile iron flanges and integral limit bolts. Each unit shall be supplied with disposable spacer blocks to facilitate correct installation. All units shall permit pipe movement of 1/4" from pipe axis with flanges

parallel and axial compression of 1/4" from the installed length. Published working pressure at operating temperature (up to 250°F.) shall be based on 4 to 1 safety factor and shall be no less than the sum of the system relief valve set pressure and the circulating pump specified operating head.

2. Alternatively, in lieu of flexible connector, Contractor may utilize groove joint mechanical couplings at the pump connectors in accordance with coupling manufacturer's installation instructions for this application. Provide a minimum of three (3) couplings at each pump connection. Mechanical couplings shall be as indicated below.

2.27 PUMP SUCTION DIFFUSERS

- A. Cast-iron body, with threaded connections for 2 inch and smaller, flanged or grooved mechanical joint connections for 2-1/2 inch and larger; 175 psig working pressure, 300 deg F maximum operating temperature; and complete with the following features:
 1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
 2. Cylinder strainer with 3/16 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.
 3. Disposable fine mesh strainer to fit over cylinder strainer.
 4. Permanent magnet, located in flow stream, removable for cleaning.
 5. Adjustable foot support, designed to carry weight of suction piping.
 6. Blowdown tapping in bottom; gauge tapping in side.

2.28 THERMOMETERS

- A. Weiss #A9VU35 adjustable angle. Blue liquid filled-magnifying lens "Blue Reading" Tube, Industrial Thermometers cast of extruded brass or aluminum closed cases, stainless steel or brass tapered bulbs with bulbs in direct contact with metal, individually calibrated tubes and engraved scales. Each 9" thermometer shall have adjustable angle and shall be installed in a matching brass separable socket with a 3/4" NPT. Stem length of socket shall be 3-1/2" except on lines where the insulation thickness exceeds 3" the stem length shall be 6" with an extension neck socket.
- B. Thermal wells in liquid lines shall be brass construction of same manufacturer as thermometers with 3/4" NPT, cap and chain, and shall have Government Standard tapered walls. Socket length shall be 3-1/2" under hex, except on lines where the insulation thickness exceeds 3" the length shall be 6" including 2-1/2" extension neck.
- C. All thermometers and thermal wells shall be by one manufacturer and shall be interchangeable.
- D. Graduation of thermometers shall be as follows:

	RANGE (°F)	DIVISIONS	FIG. INTERVAL
Chilled	0 to 120	1°F	10°

Condenser Water	0 to 120	1°F	10°
Heating Hot Water	30 to 240	2°F	20°
Heat Pump Loop	0 to 120	1°F	10°

- E. Submit shop drawings on thermometers and thermal wells.

2.29 PRESSURE GAUGES

- A. Gauges shall be equal to Weiss #PG-1

- B. Gauges shall include:

1. 4-1/2" diameter, no flange
2. Closed type ring with clear glass
3. Bronze tube, Bourdon Type
4. Silver brazed connecting joints
5. Bushed, brass rotary movement
6. 1/4" NPT bottom connections with brass tee handle cock
7. Pressure "snubbers" at locations where gauge needle pulsation might occur

- C. Submit shop drawings on gauges.

- D. Graduation of pressure gauges shall be:

	RANGE	DIVISIONS	FIG. INTERVAL
Chilled Water	0 – 100 psi	1.0 psi	10 psi
Condenser Water	0 – 100 psi	1.0 psi	10 psi
Heating Hot Water	0 – 100 psi	1.0 psi	10 psi
Heat Pump Loop	0 – 100 psi	1.0 psi	10 psi

- E. Gauge cocks shall be brass, equal to Weiss No. TC-14 or LC-14.

- F. Pressure gauges at pumps, chillers and other locations shown on the drawings shall be Flow Conditioning Corp. Hydronic Indicator Systems or equal. These gauges shall include a manifold valve and a gauge with pressure indications accurate to 1/2 of 1%. Gauges shall be as specified above with a quick set dial for pressure comparison. Manifold valve shall be spring return push-button manifold with ports for connection to system at indicated points. System shall be a four port system at pumps, and multiple ports at other locations as shown. Gauges shall be connected to sensing ports with 1/4" copper tubing.

2.30 TEST PLUGS

- A. Test plugs, 1/4" NPT, shall be arranged to allow attachment of either a thermometer or a pressure gauge. Test plugs shall have a valve core of neoprene or other material suitable for use with hot water, chilled water and condenser water. Valve core material shall also be suitable for propylene glycol and water solutions. Test plugs shall be brass, with color coded and marked cap to cover opening when not in use.

- B. Contractor shall furnish the Owner with two (2) pressure and temperature testing kits equal to series 1500 (Peterson Equipment Co.), each consisting of a 0-100 psi, 0-230 ft. water pressure gage with No. 500 gage adaptor attached, a 25-125°F pocket testing thermometer, a 0-220°F pocket testing thermometer, a No. 500 gage adaptor and a protective carrying case.
- C. Test plugs shall be equal to Model No. 110 (Pete's Plug) as manufactured by the Peterson Equipment Company, Incorporated of Richardson, Texas.

2.31 EXPANSION JOINTS

- A. Slip Joint Type Expansion joints shall comply with the following:
 - 1. Joints shall be of the internally guided slip joint type, suitable for the service in which they are installed, and shall be suitable for continuous operating pressure of 150 psi at 400°F.
 - 2. Joints shall be steel construction with flanged ends and mounting base.
 - 3. Slip joints shall be seamless steel, plated with chromium over nickel.
 - 4. Positive stops to limit movement.
 - 5. The inner end of each slip shall be a guide and stop ring designed to prevent any metal from coming into sliding contact with the chromium plated surface.
 - 6. Stuffing boxes shall be deep and fully packed with Teflon non-asbestos packing as recommended by the manufacturer. Expansion joints with non-self-lubricating packing shall have lubrication fittings.
 - 7. Drip connections.
 - 8. ADSCO type IE or equal.
- B. Bellows Type Expansion joints shall comply with the following:
 - 1. Steel Piping 3 inch and Under: Stainless steel bellows type with anti-torque device, limit stops, and internal guide.
 - 2. Steel Piping over 3 inch: External ring controlled type with hydraulically formed stainless steel bellows.
 - 3. Copper Piping: All bronze type with two-ply bronze bellows, anti- torque device limit stops, internal guides, and solder joint end.
 - 4. Copper or Steel Piping 2 inches and Under: Low pressure compensators with two-ply bronze bellows suitable for minimum 75 psi pressure and 250 degrees F, and maximum 1/2 inch expansion.
 - 5. Copper or Steel Piping Over 2 inches: Copper type with packed sliding sleeve suitable for minimum 125 psi working pressure and 250 degrees F.
 - 6. Use joints suitable for minimum 125 psi WSP and 400 degrees F, and 200 psi WOG and 250 degrees F.
 - 7. Expansion joints shall be suitable to connect to adjoining piping as specified for pipe joints. Use pipe sized units.
- C. Expansion Loops
 - 1. Expansion Loops shall comply with the following:

- a. U bend design expansion loop equal to Metraloop as manufactured by the MetraFlex Company. Loops shall be designed to impart no thrust loads on the anchors and shall consist of two flexible sections of hose and braid, two 90 degree elbows and a 180 degree return bend.
- b. For copper pipe applications, pipe fittings shall be type L copper wrought copper or bronze metal with a bronze hose and braid with fittings for solder connections, 150 psi working pressure at up to 250°F.

2.32 PIPE ALIGNMENT GUIDES

- A. Alignment guides shall be factory fabricated with split steel guiding cylinder with anchor case and split steel spider. Guiding cylinders shall be split on 45° and shall be designed to accommodate specified insulation thickness. Allow 1/8" minimum clearance between I.D. of guiding cylinder and O.D. of insulation. For chilled or cold services, guides shall include a thermal barrier between the pipe and spider.
- B. Guides shall be equal to ADSCO Model E for steel piping and Model FRC for copper. For cold services, guides shall include ITB feature.

2.33 GROOVED PIPE JOINING METHODS

- A. Contractor may use grooved pipe joining methods for the following services:
 - 1. Chilled Water
 - 2. Heating Hot Water
- B. Contractor may, at his option, if approved by the local building code, use grooved pipe, couplings, fittings, butterfly valves, and mechanical tee stub-ins in lieu of welded, flanged or threaded methods of pipe joining. If used, joining methods and components shall be approved for services up to and including 230°F. Joining methods and components shall be Victaulic, Gustin Bacon or approved equal. All methods, procedures and components shall be in compliance with the manufacturer's recommendations. System shall be suitable for 150 psi normal working pressure.
- C. Coupling Housings
 - 1. Coupling segments shall be cast of malleable iron conforming to ASTM A-47 or ductile iron conforming to ASTM A-536.
 - 2. The coupling shall be of the grooved, mechanical type which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges the pipe ends to create the seal. The coupling shall be cast in two or more parts secured together during assembly by nuts and bolts as specified. The coupling shall permit a degree of angular pipe deflection, contraction and expansion.
- D. Gaskets
 - 1. Elastomers shall have properties as designated by ASTM D-2000.

2. Gasket shall be of the mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase the seal's tightness.
 3. Gasket supplied shall be EPDM Grade "E", with green color code identification, conforming to ASTM D-2000 for water services up to 230°F.
- E. Bolts and Nuts
1. Bolts and nuts shall be heat treated carbon steel conforming to ASTM A183, minimum tensile 110,000 psi.
 2. The coupling segments shall be assembled with two or more oval neck track bolts. The nuts shall be tightened to assure firm metal-to-metal contact of the coupling bolt pads.
- F. Branch stub-in connections may be made with Victaulic Mechanical-T in lieu of welded fittings. If used, tees shall comply with the following:
1. Mechanical-T shall be cast of malleable iron conforming to ASTM A-47 or ductile iron conforming to ASTM A-536.
 2. Mechanical-T shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in the pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 50 lb. ft.
 3. Gasket shall be the same as paragraph above.
 4. Bolts and nuts shall be the same as paragraph above.
- G. Fittings shall be of grooved or shouldered end design to accept grooved mechanical couplings without field preparation.
1. Malleable Iron - ASTM A-47.
 2. Ductile Iron - ASTM A-536.
 3. Fabricated Steel - ASTM A-53, 3/4" - 1-1/2", Type F, 2-20", Type E or S, Grade B.
 4. Steel - ASTM A-234, (A-106, Gr. B) (14-24", 45°F and 90°F elbows).
- H. Flanges for connecting flanged components into the grooved system shall be Victaulic Vic-Flanges. Flanges shall conform to 125# cast-iron and 150# steel bolt hole alignment.
1. Steel Pipe - Vic-Flange for steel pipe shall be Style 741 in sizes 2-12" and Style 742 in sizes 14" and 16".
 2. Materials
 - a. Malleable Iron - ASTM A-47.
 - b. Ductile Iron - ASTM A-536.
- I. Valves. Valves may be of grooved end design in sizes 1" through 12". All valves shall have iron body, bronze disc, extended neck, 150 psig pressure rating, and stainless steel stem and disc screws. All butterfly valves 6" and smaller shall be Victaulic Series 700 butterfly valves with standard handle, Grade "E" or Grade "H" linings and standard trim. All butterfly valves 8"

through 12" shall be Victaulic Series 701 butterfly valves with manual gear operator, Grade "E" linings and standard trim. Valves shall be suitable for up to 230°F service.

- J. Pipe shall be supplied grooved in accordance with coupling manufacturer's specifications. For grooving on-site, pipe shall be prepared in accordance with the same specifications using specially designed tools.
- K. All standard steel pipe shall be black or hot-dipped galvanized, as indicated, conforming to ASTM Specification A-53, 3/4" - 1-1/2" Type F and 2" - 24" Type E or S, Grade B, and of standard weight wall thickness, manufacturer's standard square cut grooving specifications.
- L. The joints shall be assembled in compliance with the coupling manufacturer's recommendations.
- M. The requirements of MSS-SP-69, "Pipe Hangers and Supports-Selection and Application" shall in general, govern the installation of hangers and supports, in accordance with the following recommendations.

- 1. Horizontal Piping. No pipe shall be left unsupported between any two couplings nor shall any pipe be left unsupported whenever a change in direction of line flow takes place. Supports shall meet the requirements stated above but in no case shall the distance between supports exceed the following:

Pipe Size	Between Hangers
3/4 - 1"	8'
1-1/4 - 2"	10'
2-1/2 - 4"	12'
5 - 8"	14'
10 - 12"	16'

- 2. Vertical Piping. Vertical piping shall be supported at every other floor or every other pipe length, whichever is most frequent. The base of the riser or base fitting shall be set on a pedestal or foundation.

2.34 PROPYLENE GLYCOL

- A. Inhibited propylene glycol recommended by manufacturer for chilled and hot water systems. "Dowfrost" as manufactured by Dow Chemical Co. or approved equal.

2.35 DESIGN PRESSURE/TEMPERATURE SCHEDULES:

SERVICE	VALVES PSIG/°F	PIPING PSIG/°F
Chilled Water	125/150	100/150
Drains	125/150	50/150
Heating Hot Water	125/250	100/250

PART 3 - EXECUTION

3.1 See Section 230100 for piping installation.

3.2 HYDRONIC SPECIALTIES INSTALLATION:

- A. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.
- B. Install inline air separators in pump suction lines. Install automatic air vent on top of separator and pipe discharge to floor drain unless otherwise indicated. Install drain valve on units 2 inch and larger.
- C. Install strainer blowdown piping with ball valve; extend to nearest drain.
- D. Install pump suction diffusers on pump suction inlet where indicated, adjust foot support to carry weight of suction piping. Install nipple and ball valve in blowdown connection.
- E. Install pump discharge valves in horizontal or vertical position with stem in upward position. Allow clearance above stem for check mechanism removal.
- F. Install diaphragm-type compression tanks on floor or at ceiling as indicated. Vent and purge air from hydronic system, charge tank with proper air charge to suit system design requirements.
- G. Install flexible pipe connectors on pipes connected to equipment where indicated.
 - 1. Rigidly anchor pipe to building structure where necessary.
 - 2. Install flexible pipe connectors in accordance with manufacturer's instructions. Align joints to avoid end loading and torsional stress.
- H. Install ASME pressure relief valves on all portions of the piping systems which during normal usage could be isolated from the expansion system by manual or automatic valves. Valves shall be set to relieve at 125 PSI, unless otherwise indicated.
- I. Install expansion joints and compensators where indicated and where required to control expansion and contraction of piping, loops, pipe offsets, and swing joints. Install corrugated bellows type expansion joints where required. Rigidly anchor pipe to building structure where necessary in accordance with manufacturer's guidelines. Provide pipe guides so that movement takes place along axis of pipe only.
- J. Install a P/T plug at each water sensor which is an input point to the control system.
- K. Install balance valves in accordance with manufacturer's written installation instructions. Provide a minimum of 2 diameters of straight pipe downstream of the balance valve, a minimum of 5 diameters of straight pipe upstream of the balance valve to any pipe fitting, valve, control valve or thermal well, and a minimum of 10 diameters upstream of the balance valve to any pump discharge.

3.3 PROPYLENE GLYCOL

- A. Thoroughly clean and flush piping before adding glycol. See section 230910.
- B. Fill piping systems indicated with inhibited propylene glycol to give 25% +/- 1% concentration in chilled water system. Furnish a drum pump and hoses or other feeding equipment required.
- C. Measure the concentration of the glycol in the system(s) and report in writing to the Engineer.

END OF SECTION 230110

SECTION 230150 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, material, services and related items necessary for the refrigerant piping systems shown on the plans and as specified herein. These systems shall include:
 - 1. Refrigerant Piping
 - 2. Refrigerant
 - 3. Refrigerant Piping Specialties
- B. Coordinate refrigerant pipe size with refrigerant component manufacturer.

1.2 RELATED DOCUMENTS

- A. All applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Mechanical Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.

1.3 REFERENCES

- A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 34 - Number Designation of Refrigerants.
- C. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels.
- D. ANSI/ASME SEC 9 - Boilers and Pressure Vessels Code, Welding and Brazing Qualifications.
- E. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- F. ANSI/ASME B31.5 - Refrigeration Piping.
- G. ANSI/ASME B31.9 - Building Services Piping.
- H. AWS - Brazing.
- I. ANSI/ASTM B88 - Seamless Copper Water Tube.
- J. ANSI/AWS A5.8 - Brazing Filler Metal.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.
- C. Welder's Certification: In accordance with ANSI/ASME SEC 9.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 230000 - Mechanical General Conditions.
- B. Submit shop drawings indicating isometric layout of system, including equipment, critical dimensions, and sizes.
- C. Submit product data indicating general assembly of specialties, including manufacturer's catalog information.
- D. Submit manufacturer's installation instructions under provisions of Section 230000.
- E. Submit welder's certification of compliance with ANSI/ASME SEC 9.
- F. Submit test reports indicating results of leak test, acid test.
- G. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All refrigerant and refrigerant oil shall be delivered to the site in factory sealed containers.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.
- C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPE AND FITTINGS

- A. Piping: Copper Tubing, ASTM B280, Type ACR, hard drawn, factory cleaned, dehydrated and pre-charged with nitrogen. "ACR" as manufactured by Mueller Brass Company or equal.
- B. Fittings: ANSI/ASME B16.22 wrought copper or forged brass.
- C. Brazing Filler Metals: AWS A5.8/A5.8M.
- D. Joints: All joints shall be brazed with a constant bleed of nitrogen to prevent formation of oxide or scale.

2.2 REFRIGERANT LINE KITS

- A. Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with refrigerant, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
 - 1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 3/8 inch thick.

2.3 REFRIGERANT SPECIALTIES

- A. Manufacturers: One manufacturer has been listed with the various specialties to establish desired type. Equal product of the following manufacturers are acceptable.
1. Expansion valves, solenoid valves, filter driers, moisture and liquid indicators.
 - a. Alco Valve Company
 - b. Sporlan Company
 - c. Mueller Brass
 2. Valves, strainers, check valves, relief valves.
 - a. Mueller Brass
 - b. Henry Valve Company
 - c. Superior Valve Company
 - d. Vilter
 - e. York
 3. Receivers
 - a. Standard Refrigeration
 - b. Vilter
 - c. E. L. Nickel
 4. Flexible Connectors
 - a. Resistoflex
 - b. Flexonics
 - c. Keflex
- B. Shut off Valves: Packed, back seating type with seal cap and arranged for straight through flow. Valves shall be full line size with renewable seats, brass body. Capable of being re-packed under line pressure. Rated for maximum working pressure of 500 psi and maximum temperature of 275 degrees F. Mueller Brass "Globemaster".
- C. Filter Driers:
1. Sealed type: "Catch-All" by Sporlan Valve Company. UL listed. Size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.
 2. Replaceable Cartridge Angle Type: ANSI/ARI 710, UL listed, brass shell and bronze cap, perforated brass shell and molded desiccant filter core; size of drier as recommended by manufacturer with a maximum drop of 1 PSI. Rated for maximum working pressure of 350 psi.

- D. Sight Glasses: Liquid and moisture indicating type, "Eye-Spy" by Alco Valve. Full line size. Where line size is larger than standard sight glass size, install in bypass line using manufacturer's bypass kit in accordance with manufacturer's recommendations.
- E. Solenoid Valves: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, with solder ends; for maximum working pressure of 500 psi. Stem shall permit manual operation in case of coil failure. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with integral junction box; ANSI/UL 429.
- F. Expansion Valves: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube, remote sensing bulb and remote bulb well.
 - 1. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.
- G. Strainers: Brass shell, cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.
- H. Check Valves:
 - 1. Globe Type: Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
 - 2. Straight Thru Type: Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.
- I. Pressure Relief Valves: Straight Thru or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 235 psi setting; selected to ANSI/ASHRAE 15.
- J. Receivers:
 - 1. Internal Diameter 6 inch and Smaller: ANSI/ARI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
 - 2. Internal Diameter Over 6 inch: ANSI/ARI 495, welded steel, tested and stamped in accordance with Section 8D of the ANSI/ASME Boiler and Pressure Vessels Code; 400 psi with tappings for inlet, outlet and pressure relief valve.
- K. Flexible Connectors: Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 500 psi.

- L. Refrigerant: R-32.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Install piping as shown on the plans with no additional bends or offsets. If a conflict occurs between refrigerant piping and other building components, notify the Engineer for resolution before proceeding.
- B. Piping may be pre-insulated line sets if approved by the manufacturer of the condenser, condensing unit, evaporator, and other refrigeration components.
- C. If refrigerant pipe sizes are not shown on the plans, sizing and routing shall be in accordance with the refrigerant component manufacturer's recommendations. If refrigerant pipe sizes are shown on the plans, verify refrigerant pipe sizing and routing with the manufacturer of the condenser, condensing unit, evaporator, and other components PRIOR TO THE INSTALLATION of any piping and report to the Engineer if the sizes or routing are in conflict with the manufacturer's recommendations. Install piping of the sizes recommended by the manufacturer at no additional cost to the Owner or Engineer.
- D. All components of the refrigerant system shall be designed for the type of application, refrigerant, and the system pressures encountered. All components, methods of installation, testing procedures, etc., shall be in accordance with all applicable codes.
- E. Hanging and supporting of refrigerant piping shall be as specified in Section 230100, Installation of Mechanical Piping.
- F. Pitch piping in the direction of flow with no pockets or traps other than those indicated on the plans. Oil traps that are indicated shall be made as small as possible and still retain the intended function.
 - 1. Refrigerant piping in VRF systems shall meet all manufacturer requirements.
- G. When brazing, 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.

3.2 INSTALLATION OF REFRIGERANT SPECIALITIES

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Filter Driers
 - 1. Provide permanent filter-driers in low temperature systems, systems utilizing hermetic compressors, and where indicated.
 - 2. Provide replaceable cartridge filter-driers vertically in liquid line adjacent to receivers.
 - 3. Provide replaceable cartridge filter-driers, with three-valve bypass assembly.

4. Provide filter-driers for each solenoid valve.

C. Sight Glasses

1. Provide sight glasses ahead of all solenoid valves and where indicated.
2. Provide line size sight glasses in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.

D. Solenoid Valves

1. Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down, and where indicated.
2. Provide electrical connection to solenoid valves.

E. Expansion Valves

1. Provide expansion valves in liquid line at each connection to DX coils (distributor) and where indicated.
2. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
3. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

F. Strainers

1. Provide line size strainer upstream of each automatic valve. Where multiple expansion valves with integral strainers are used install single main liquid line strainer.

G. Shut Off Valves

1. Provide shut-off valves on each side of strainer and where indicated.
2. Provide refrigerant charging (packed angle) valve connections in liquid line between receiver shut-off valve and expansion valve.

H. Check Valves: Install where indicated.

I. Relief Valves: Install where required by code and where indicated.

J. Receivers: Install where indicated.

K. Flexible Connectors

1. Utilize flexible connectors at or near compressors where piping configuration does not absorb vibration and where indicated.
2. Install flexible connectors at right angles to axial movement of compressor.

3.3 TESTING

- A. Testing for pre-charged refrigerant line kits is not required.
 - B. When installation of field installed refrigerant piping and fittings is complete, disconnect and cap all lines to gauges, controllers, etc., which might be damaged by a pressure test. Open all service valves in systems and charge system with refrigerant in accordance with the manufacturer's written requirement. Add sufficient dry nitrogen to raise system to pressures on suction, discharge and liquid sides of system as indicated below (or higher if required by local code). Check all joints and connections for leaks with a halide torch or electronic leak detector. If leaks are found, all leaks shall be repaired and system retested.
 - C. After system is proven to be completely free of leaks, the entire system shall be dehydrated by evacuating with vacuum pump. System compressors shall not be used as a vacuum pump. Pull system down to 100 microns and hold for 8 hours. Break vacuum with dry nitrogen. Repeat procedure three times with vacuum being broken the last time with refrigerant. Charge system with refrigerant and check the equipment in accordance with manufacturer's recommendations.
 - D. DO NOT DISCHARGE ANY REFRIGERANT TO THE ATMOSPHERE.
 - E. Test Pressure Requirements
 - 1. Line Test Pressure for Refrigerant R-32:
 - a. Suction Lines for Air-Conditioning Applications: 300 psig.
 - b. Suction Lines for Heat-Pump Applications: 535 psig.
 - c. Hot-Gas and Liquid Lines: 535 psig.
- 3.4 Troubleshoot all components of the refrigerant system, both new and existing, when the refrigeration system is started up until the system is operating satisfactorily.

END OF SECTION 230150

SECTION 230200 – MECHANICAL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, services, material and related items necessary to complete the thermal insulation work indicated on the drawings and/or specified herein.
 - 1. Mechanical Piping.
 - 2. Ductwork.

1.2 WORK EXCLUDED

- A. Work not included in this Section that is specified in other Sections of these specifications:
 - 1. Insulation saddles for the piping system - Section 230110.
 - 2. Plumbing systems piping insulation - Section 220400.
 - 3. Duct liner - Section 230900.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230100 - Installation of Mechanical Piping.
- D. Section 220400 - Plumbing Systems (plumbing piping insulation).
- E. Section 230900 - Air Distribution.

1.4 QUALITY ASSURANCE

- A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 method.
- B. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Submit product data under provisions of Section 230000. Indicate application for each product.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Store insulation in a clean, dry place and protect against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

1.7 REFERENCES

- A. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.
- C. NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- D. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
- E. ASTM C 547 Standard Specification for Mineral Fiber Pipe Insulation.
- F. ASTM C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- G. ASTM C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- H. ASTM C 1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- I. ASTM C 1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- J. ASTM C 1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- K. ASTM C 1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation.

PART 2 - PRODUCTS

- 2.1 The piping insulation material for each Type is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:
 - A. Owens-Corning

- B. Certain-Teed
- C. Manson Insulation
- D. Knauf Insulation
- E. Johns Manville
- F. Rubatex
- G. Armacell

- 2.2 Type (1) - Fiberglass Preformed Pipe Insulation: Glass fibers bonded with thermosetting resin, complying with ASTM C547, Type I. Fiberglass with factory-applied, ASJ+ SSL+ all service polymer jacket with self- sealing lap down joints and butt strips, complying with ASTM C1136. Vapor barrier in jacket, <.01 perm rating. Thermal conductivity shall be 0.23 BTU/HR/SF°F/IN @ 75°F mean temperature, 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F or less. Owens-Corning Fiberglass, Fiberglass 25 with ASJ Max all service jacket with a polymer film exterior surface, seal down lap joints, vapor barrier in jacket or equal by others listed above. PVC jacket over fittings. Aluminum jacket over straight sections of piping located outdoors.
- 2.3 Type (2) - Flexible Elastomeric Insulation: Armatuff Plus II (Flame/Smoke Rating less than 25/50 thru 1" thickness per ASTM E-84) Armaflex foamed plastic flexible sheeting laminated with a white thermoplastic rubber membrane (TPR). TPR membrane shall be UV resistant with a 25 year warranty. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature.
- 2.4 Type (3) - Flexible Elastomeric Insulation: Armacell AP/Unslit (Flame/Smoke Rating less than 25/50 thru 1" thickness per ASTM E-84) Armaflex foamed plastic flexible tubing insulation Unslit. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. See Execution for allowable locations of Lap Seal.
- A. Provide Armafix insulated pipe hangers at all pipe hangers for continuous vapor barrier.
- 2.5 Type (4) - Fiberglass Rigid Board Insulation: Owens Corning type 703-FRK-25, 3 pound per cubic foot density, rigid insulation. Temperature range -60°F to 450°F. "K" value (BTU/HR/FT^2/IN/F) of 0.23 or less at 75 degrees F and 0.30 at 100 degrees F. Factory applied FSK vapor barrier. Odor free and resistant to growth of bacteria or fungus.
- 2.6 Type (5) - Fiberglass Rigid Board Insulation: Owens Corning type 705-FRK-25, 6 pound per cubic foot density, rigid insulation. Temperature range -60°F to 450°F. "K" value (BTU/HR/FT^2/IN/F) of 0.23 or less at 75 degrees F and 0.30 at 100 degrees F. Factory applied FSK vapor barrier. Odor free and resistant to growth of bacteria or fungus.
- 2.7 Type (6) – Fiberglass Flexible Blanket Insulation: Owens Corning All-Service Duct Wrap, 1.0 pound per cubic foot density, blanket type insulation with all service facing with a 2" min. stapling and taping flange on one edge. Temperature range -60°F to 250°F. Factory applied reinforced Foil-Kraft (FRK) vapor barrier. Odor free and resistant to growth of bacteria or fungus. Installed thicknesses and R-Values as indicated below.

(* hr-ft²-°F/Btu at 75°F mean temperature.) & (** Assumes 25% compression of insulation.)

Nominal			Installed	
Thickness,	Density	Out-of-Package	Thickness,	Installed

in.	pcf	R-Value*	in.	R-Value*
1 ½	.75	5.1	1 1/8	4.2
1 ½	1.0	5.6	1 1/8	4.5
1 ½	1.5	6.1	1 1/8	4.8
2	.75	6.8	1 ½	5.6
2	1.0	7.4	1 ½	6.0
2	1.5	8.2	1 ½	6.4
2 3/16	.75	7.5	1.65	6.0
3	.75	10.2	2 1/4	8.4
4	.75	14.7	3 1/4	12.0

- 2.8 Type (7) – Hydrous calcium silicate: ANSI/ASTM C533; rigid white; asbestos free; 'k' value of 0.44 at 300 degrees F, 15 pcf maximum dry density, 60 psi minimum compressive strength at 5 percent deformation. Aluminum jacket over straight sections of piping and fiberglass cloth jacket over fittings.
- 2.9 Type (9) - Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat faced on both major surfaces; maximum board size 48 inches by 96 inches; not less than 2 lbs/cu. ft. density per ASTM D 1622; not less than 20 psi compressive strength; factory-tapered insulation boards fabricated to slopes indicated. Flame Spread: Not greater than 50; ASTM E 84. Smoke Developed: Not greater than 170; ASTM E 84. Tapered Board Insulation: Fabricated to slope of 1/4 inch per 12 inches (1:48) or 1/2 inch per 12 inches (1:24) as noted on the details unless otherwise indicated.
- A. Insulation Fasteners: Factory-coated steel fasteners and metal plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening insulation and cover boards to substrates, acceptable to membrane manufacturer.
- 2.10 Type (10) - Flexible Elastomeric Insulation: Armaflex W (Flame/Smoke Rating 25/50 thru 1" thickness) Armaflex white foamed plastic flexible tubing insulation, unslit. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. Available ½" thick thru 2-5/8" ID and 3/4" or 1" thick thru 4-1/8" ID.
- 2.11 Type (11) - Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- A. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - Acceptable manufacturers:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
- B. Cellular-Glass Joint Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 4. Color: White or gray.
 - a. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 5. Acceptable Manufacturers:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
- 2.12 Type (12) - Flexible Elastomeric Insulation: Armaflex AP White Unslit (Flame/Smoke Rating 25/50 thru 1" thickness) Armaflex white foamed plastic flexible tubing insulation, Unslit. UV resistant thermal conductivity of 0.28 BTU/HR/SF°F/IN @ 90°F mean temperature. Available ½" thick thru 2-5/8" ID and 3/4" or 1" thick thru 4-1/8" ID. See Execution for allowable locations of Lap Seal.
 - A. Provide Armafix insulated pipe hangers at all pipe hangers.
- 2.13 JACKETS
 - A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
 - B. PVC Jackets: One piece, premolded type.
 - C. Aluminum Jackets: ASTM B209; 0.032 inch thick; Stucco Embossed corrugated finish; 2-1/2" deep corrugations. Childers jacketing system, ITW Insulation system, or equal.
 - 1. Finish and thickness are indicated in field-applied jacket schedules.
 - 2. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper or 2.5-mil thick polysurlyn.
 - 3. Moisture Barrier for Outdoor Applications: 2.5-mil thick polysurlyn.
 - D. Vapor barrier mastic coatings:

1. for outdoor service: Foster Division - 30-15
 2. for indoor service: Foster Division - 30-80 or 30-90 (water based)
 3. Or equal products by the following manufacturers:
 - a. Exxon Chemical Company USA
 - b. Insul - Coustic IC
 - c. Epolux-Cadalar
- E. Reinforced Polyvinyl-Chloride (PVC) Flashing Sheet: ASTM D 4434, Type III, fabric reinforced and fabric scrim-backed; felt backed; capable of being heat-welded. Sheet Thickness: 30 mils, nominal.
- F. Thermoplastic Polyolefin (TPO) Flashing Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet; free of surface defects and embossing or marking which affect membrane thickness or performance; capable of being heat-welded. Thickness: 60 mils, nominal. (For use on ductwork exterior location where indicated on the plans.)
- G. Removable/Reusable Valve Covers:
1. Cover shall be factory fabricated of 1" close cell elastomeric insulation (Flame/Smoke rating less than 25/50 per ASTM E-84) with Velcro closures. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature. Cover shall overlap adjoining sections of pipe insulation and shall totally enclose all portions of the valve being covered. Installation shall not require the use of any special hand tools. As manufactured by Corick, Baton Rouge, Louisiana, or approved equal.
- H. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Acceptable Products and Manufacturers:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.
- I. PVC Insulation Fitting Covers:
1. Factory fabricated, pre-molded, fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 2. Factory fabricated, pre-molded, fiberglass fitting inserts, 1-1/2 pound per cubic foot density, semi-rigid insulation formed to fit the pipe fitting, valve, etc. that it is designed to cover.
 3. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, traps, and mechanical joints.
 4. Acceptable manufacturers:
 - a. P.I.C Plastics
 - b. Shur-Fit Products
 - c. Speedline Corporation, (Smoke-Safe)
 - d. Proto Corporation, (Lo SMOKE)
 - e. Johns Manville, (Zeston)

5. Adhesive: Compatible with fitting cover material. Do not use regular PVC cement.

a. Acceptable manufacturers:

- 1) Ceel-Co, "Ceel-tite #300" Solvent Welding Adhesive
- 2) Knauf, "Proto Solvent Adhesive"
- 3) Manville, "Perma-Weld Adhesive"
- 4) Aluminum fitting covers by GASCO are equally acceptable.

2.14 ACCESSORIES

- A. Insulation Bands: $\frac{3}{4}$ inch wide; 0.015 inch thick galvanized steel.
- B. Metal Jacket Bands: $\frac{3}{8}$ inch wide; 0.015 inch thick aluminum.
- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Finishing Cement: ASTM C449.
- E. Fibrous Glass Cloth: Untreated; 9 oz/sq yd weight.
- F. Adhesives/Tapes: Compatible with insulation.
- G. Flexible elastomeric foam finish-Armstrong FR/Armaflex finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION

- A. Install insulation, vapor retarder and jacketing per manufacturer's recommendations. Particular attention should be paid to recommendations for joint staggering, adhesive application, external hanger design, expansion/contraction joint design and spacing and vapor retarder integrity.
- B. Insulate all pipe, valves, and specialties except where insulation is specifically indicated to be omitted.
- C. All insulation shall be continuous through wall, floor, and ceiling openings and sleeves.
- D. Install insulation with all joints tightly butted (except expansion joints in hot applications).
- E. Piping insulation and jacketing shall be applied in accordance with MICA (Midwest Insulation Contractors Association) Plate #3 (b) requirements. Insulation at hangers shall be applied in accordance with MICA Plate #6A. Insulation for fittings, valves, flanges, and couplings shall be installed in accordance with MICA Plates 10-18.
- F. The open end of all insulation shall be neatly beveled either by beveling the insulation or by using finish cement.
- G. Prior to application of insulation, heat tracing, or painting; piping and equipment shall have been tested and accepted.
- H. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.
- I. All pipe lines with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or

should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete. Where pipe hangers are installed in a manner that prevents the specified insulation thickness to be installed, the pipe hangers shall be adjusted or moved and rehung to allow the specified insulation thickness to be applied.

- J. Where insulated piping is supported by hangers clamped directly to the pipe, the insulation shall be carefully fitted around hanger clamp and sealed at openings in jacket.
- K. For all cold service piping:
 - 1. Seal the beginning and end of each run of insulation to the pipe being insulated with vapor barrier mastic to prevent air from entering the space between the pipe and the insulation. This especially applies at connections to air handling units and similar equipment. See details on plans.
 - 2. Install a vapor stop on each side of all valves that are not fully encapsulated by the insulation including all valves where the stem or handle protrudes outside the insulation. The vapor stop shall consist a vapor barrier and mastic to prevent moisture from traveling longitudinally along the insulation in the space between the pipe and the insulation. See details on plans.
 - 3. Vapor retarder/seal shall be installed in a continuous manner. No staples, rivets, screws or any other attachment device capable of penetrating the vapor retarder/seal shall be used to attach the vapor retarder/seal or jacketing. No wire ties capable of penetrating the vapor retarder/seal shall be used to hold the insulation in place. Banding shall be used to attach PVC or metal jacketing.
 - 4. Where cold service piping attaches to coils in air handling equipment, vapor seal the end of the insulation and seal insulation to air handling unit casing. Seal in accordance with air handling unit manufacturer's installation instructions or as directed by the Engineer.
- L. Insulate heating and cooling coil headers located outside of units or ductwork or not located above a condensate pan as specified for piping.
- M. Unions, flanges and valves:
 - 1. All unions, flanges, valves and other similar fittings shall be insulated unless otherwise indicated.
 - 2. Extended Stems: Where insulation is indicated or specified, coordinate with contractor furnishing valves to furnish extended stems arranged to receive insulation. Cold service valves that are insulated with removable covers do not require extended stems.
 - 3. For all cold service piping:
 - a. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with molded, pre-shaped fiberglass insulation inserts and cover with a two piece PVC Fitting Cover. Insulation and fitting cover shall be removable. Secure the two piece PVC fitting cover by taping the ends to the adjacent pipe covering. All seams of cover shall be sealed with vapor barrier pressure sensitive color matched tape.

- b. Insulate all balance (flow control) valves, flow measuring devices, and stop valves (except valves located in mechanical rooms and valves exterior to the building) with factory fabricated removable/reusable valve covers. Install in accordance with the manufacturer's instructions to prevent the condensation. All removable valve covers shall be the same manufacture.
 - c. Insulate all fittings, control valves, manual valves (in mechanical rooms and valves exterior to the building), check valves, unions, instruments, hanger rods and clamps, and flanges with molded, pre-shaped insulation inserts of the same material as the straight pipe insulation, or wrap the fitting, valve, etc. with 1.5-pound density flexible fiberglass insulation to a thickness equal to the adjacent piping insulation, and cover with a one piece PVC Fitting Cover per MICA Plate 17A or 18. Tuck the ends of the insulation snugly into the throat of the fitting and the edge adjacent to the pipe fitting. Secure the one piece PVC fitting cover by taping the ends to the adjacent pipe covering. All seam edges of cover shall be sealed with vapor barrier pressure sensitive color matched tape. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2 inches. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
4. For all hot service piping:
- a. Insulate all fittings, manual valves, hanger rods and clamps, and flanges with molded, pre-shaped insulation inserts of the same material as the straight pipe insulation, or wrap fiberglass installations with 3-pound density flexible fiberglass insulation to a thickness equal to the adjacent piping insulation, and cover with a one piece PVC Fitting Cover. Tuck the ends of the insulation snugly into the throat of the fitting and the edge adjacent to the pipe cover. Secure the one piece PVC fitting cover by taping or riveting the ends to the adjacent pipe covering. Use of polyurethane spray-foam to fill PVC elbow jacket is prohibited on cold applications.
 - b. Insulate all control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, check valves, unions, instruments similar to fittings as indicated above.
 - c. Insulate all float, float and thermostatic, inverted bucket and orifice steam traps. Do not insulate thermostatic or thermodynamic type steam traps.
- N. At pipe hangers, furnish and install a sheet metal protection shield and wooden inserts the same thickness as the insulation. Shields and blocks are intended to prevent the crushing of the insulation. Blocks shall be sealed to provide continuity of the vapor barrier.
1. In lieu of the wooden blocks at pipe hangers, this Contractor may, at his option, provide rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket. Thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation lengths shall be three (3) times the pipe diameter plus 8" with a minimum length of 20". Insulation thickness shall be the same as the pipe insulation.
- O. Exterior Applications

1. Type 1, 7 or 8: Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.
2. Type 2, 3 or 12: Coat with flexible elastomeric foam finish per manufacturer's instructions.

3.2 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
5. Only where Unslit Insulation cannot be installed and longitudinal slit is needed, provide Lap Seal insulation. The longitudinal slit should only be used when insulating existing piping.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange cellular glass insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.3 DUCT INSULATION

- A. Installation shall comply with the manufacturer's recommendations using manufacturer's recommended procedures, adhesives, joint tape, and methods.
- For ducts 18" and larger in width, welding pins shall be used on not greater than 16" o.c. on the bottom and sides of the ducts and maximum 3" from insulation joints to prevent sagging. Pins shall be covered with duct tape. All parts of the duct system shall be insulated in such a manner to form a continuous insulation and prevent excessive heat loss, heat gain, or condensation.
 - For ducts 18" and smaller, place pins along long individual centerline of duct. Space 3" inches maximum from insulation end joints and 16" inch on center.

3.4 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.5 INSULATION THICKNESS

- The following piping requires field applied insulation:

System		Insulation Type	Thickness
Condensate Drain Lines (Inside Building)		3	1/2"
Hot/Chilled Dual Temperature Water Piping - (Interior Locations)	1/2" to 1 1/2"	1	1-1/2"
	2" to 16"	1	2"
Refrigerant Suction Gas Piping		3	1/2"
Refrigerant Suction Gas Piping (attic)		3	3/4"
Refrigerant liquid piping on any piping lengths over 75ft		3	1/2"
Refrigerant liquid piping (attic)		3	3/4"
Refrigerant liquid piping (exterior)		12	1"
Refrigerant suction gas piping (exterior)		12	1"
Any Pipe Thru Rated Wall where Details Show This density is required		5	Match thickness above

- The following ductwork requires field applied insulation:

System	Insulation Type	Thickness
All ductwork in Equipment rooms	6	1-1/2"

END OF SECTION 230200

SECTION 230810 - PACKAGED HEATING/COOLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Furnish all labor, services, material and related items necessary to complete the Packaged AC Unit installation indicated on the drawings and/or specified herein. Type of units specified in this section:
 - 1. Split System Air Conditioners

1.2 RELATED DOCUMENTS:

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Material and Methods.
- D. Section 230020 - Vibration Isolators and Seismic Restraints.
- E. Section 230110 - HVAC Water Systems Piping.
- F. Section 230960 - Temperature Controls.

1.3 REFERENCES:

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 210 - Unitary Air-Conditioning Equipment.
- C. ARI 240 - Air Source Unitary Heat Pump Equipment.
- D. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- E. ANSI/NFPA 70 National Electrical Code.
- F. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

1.4 QUALITY ASSURANCE:

- A. All units shall be rated and certified as complete units in accordance with ARI Standard 210/240-94 and shall bear the ARI seal. Cooling capacity ratings shall be based on ARI Standard 340/360-93 requirements.
- B. Units, and all accessories, shall be listed by Underwriter's Laboratories, Inc. and bear the appropriate UL label.

1.5 SUBMITTALS:

- A. Submit shop drawings and product data under provisions of Section 230000.
- B. Submit shop drawings, product data, manufacturer's installation instructions and operation and maintenance data for manufactured products and assemblies required for this project.
- C. Indicate electrical service and duct connections on shop drawings or product data.

- D. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- E. Include calibration certification documentation of factory installed temperature, humidity, enthalpy and CO2 control sensors.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Deliver products to site and hoist in place.
- B. Protect units from physical damage.

1.7 WARRANTY:

- A. Entire unit shall have a one year warranty as described in Section 230000. The compressor shall be warranted an additional four (4) years beyond the first year. The additional four years for the compressor shall be for parts only and shall not include labor.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM HEAT PUMP

- A. Acceptable Manufacturers:
 - 1. Mitsubishi
 - 2. Daikin
 - 3. Carrier
 - 4. Samsung
 - 5. LG
- B. Units shall be a split system heat pump system comprised of an evaporator unit and a condensing unit of the size and capacity shown on the equipment schedules.
- C. Components shall be designed for compatibility and shall be rated in accordance with applicable ARI Standards.
- D. Units shall contain a holding charge of R-32 refrigerant. Provided refrigerant tubing including insulation on the suction and liquid lines between the condensing unit and the evaporator.
- E. Unit casing panels for evaporator and condensing units shall be of 22 gauge steel, cleaned, phosphated and coated with resin primer and baked enamel finish. Removable panels shall provide complete access for servicing compressors and electrical control.
- F. Condensing Units:
 - 1. Direct expansion air cooled condensing units shall be of the type, number and configuration shown on the plans. Each unit shall be a complete factory package consisting of compressor, condensing coil, condenser fans and motors, casing and refrigeration and temperature controls.
 - 2. Compressor:

- a. Compressor shall be serviceable hermetic type. Compressor shall contain crankcase heater, vibration isolators, and shall be located in a separate section from condenser fans and coil.
 - b. Compressor shall be capable of starting and sustained operation in cooling mode to -10°F ambient when indoor unit is supplied without an economizer.
 - 3. Refrigerant System Safety Controls: All compressors shall be provided with the following minimum protection:
 - a. Overcurrent
 - b. Over temperature
 - c. Short cycle with lock-out light on room thermostat
 - d. High pressure relief
 - e. Low pressure relief
 - f. Liquid slugging (suction line accumulator)
 - g. Loss of charge
 - 4. Condenser coil shall have aluminum plate fins mechanically bonded to copper tubes, cleaned, dehydrated, leak tested at 150 psig and pressure tested at 450 psig.
 - 5. Condenser Fans and Motors:
 - a. Fans shall be of the direct driven propeller type with steel wire safety guards and shall be balanced statically and dynamically.
 - b. Fan motors shall have inherent overcurrent and over temperature protection.
- G. Indoor Packaged Evaporator Unit:
- 1. Evaporator unit shall be a packaged wall mounted air handler consisting of direct expansion evaporator coil, insulated condensate pan, refrigerant accessories, forward curved fans, motor and direct drive, insulated casing and washable filter.
 - 2. Coil shall be aluminum plate fins mechanically bonded to copper tubes, cleaned, dehydrated, leak tested and sealed at the factory.
 - 3. Fans and Motors:
 - a. Indoor blowers shall be forward curved multiple wheel centrifugal type capable of delivering the required CFM at the external static pressure specified in the equipment schedule.
 - b. All fans shall be direct driven.
- H. Refrigerant Piping:
- 1. Copper Tubing to 7/8 inch OD: ANSI/ASTM B88, Type K, annealed.
 - 2. Fittings: ANSI/ASME B16.26 cast copper.
 - 3. Joints: Flared.
 - 4. Suction & Liquid Line Insulation: closed cell rubber with flame spread rating less than 25 and smoke developed rating less than 50 in compliance with ASTM E 84 (NFPA 255) testing methods. See also 230200 for additional requirements.

- I. Provide insulated casing and condensate drain pan. Insulation shall be sufficient to prevent condensation on the exterior of the casing or drain pan in a with 95°F and 80% relative humidity environment.
- J. Unit shall be controlled from a wall mounted thermostat. Supply thermostat with unit.

PART 3 - EXECUTION

- 3.1 Examine areas and conditions under which units are to be installed, notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- 3.2 Installation of Split System Air Conditioners
 - A. Install indoor fan units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
 - B. Connect refrigerant piping, ductwork and condensate drain line. Route condensate drain to nearest floor drain.
 - C. Provide vibration isolators and seismic restraints in accordance with Section 230020.
 - D. Install condensing units, where indicated on drawings, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
 - E. Condensing units shall be located as indicated on the plans.
 - F. Provide refrigerant piping of the sizes shown on the drawings in accordance with manufacturer's recommendations.
 - G. Charge per manufacturers specifications with R-32. Do NOT discharge any refrigerant to the atmosphere.
 - H. Insulate piping. Paint all insulation exposed to sunlight.
 - I. Room thermostat shall be turned over to temperature controls contractor and shall be installed under Section 230960.

END OF SECTION 230810

SECTION 230900 – AIR DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.
- B. Furnish all labor, services, material and related items necessary to complete the ductwork installation indicated on the drawings and specified herein.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Basic Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.
- E. Section 230200 - Mechanical Insulation - external duct insulation.
- F. Section 230930 - Testing and Balancing.

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Latest edition shall apply unless otherwise indicated.
- B. AMCA 500 - Test Method and Louvers, Dampers and Shutters.
- C. ASTM A 36 - Carbon Structural Steel.
- D. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- E. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
- F. ASTM A 480 - General Requirements for Flat-Rolled Stainless Steel, Sheet and Strip.
- G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
- K. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- L. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- M. AWS D9.1 - Welding of Sheet Metal.
- N. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- O. NFPA 96 - Installing of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- P. SMACNA -HVAC Air Duct Leakage Test Manual, 1st Edition.
- Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible. (2005 Third Edition) (subsequently referenced as "SMACNA 2005").
- R. UL 33 - Standard for Safety Heat Responsive Links for Fire Protection Service.
- S. UL 181 - Standard for Safety Factory-Made Air Ducts and Connectors.

- T. UL 555 - Standard for Fire Dampers.
- U. UL 555S - Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.
- V. UL 2043 - Fire test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Section 230000.
- B. Product data including materials, details of construction, dimensions of individual components, profiles, manufacturer's installation instructions, and finishes for the following items:
 - 1. Air Devices: Submit schedule of outlets and inlets indicating type, size, accessories, finish/color, type of mounting, air performance, static pressure drop, throw, and noise level.
 - 2. Duct Liner
 - 3. Sealant and Gasket Materials
 - 4. Fire-Stopping Materials
 - 5. Flexible ducts and clamps, with manufacturer's installation instructions
 - 6. Flexible Connectors
 - 7. Fire Dampers and Sleeves
 - 8. Backdraft Dampers
 - 9. Balance Dampers
 - 10. Access Doors
 - 11. Louvers
- C. Shop drawings for duct fabrication, drawn to a scale not smaller than 1/8 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
 - 1. Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, gage and reinforcement.
 - 2. Fabrication, assembly, and installation details. Include details of components, and attachments to other work.
 - 3. Fittings, turning vanes and vane attachments to elbows.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Terminal unit installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
 - 9. Location and details for seismic restraints.
- D. Ductwork Reinforcement Information: Submit information on the duct reinforcement to be used for each section of duct. Information shall include copies of tables from SMACNA construction standards highlighting the actual duct sizes, pressure class, material, gauge, reinforcement type and spacing, joint type and spacing, applied loads, and hanger type and spacing. When alternate methods of sizing are used as provided by SMACNA, provide calculations to support the reinforcement selection.

- E. Proposed deviations of materials and methods from these specifications require approved submittal information prior to any construction. Submittals should clearly note that the submittals is for a change to the specifications and identify the applicable paragraph from this specification. Submittals shall include physical descriptions and results of testing and analysis to support the equal performance of the substituted items. Testing and analysis shall follow the guidelines for "Functional Criteria" from SMACNA standards.
- F. Record drawings indicating duct actual routing in accordance with Section 230000.
- G. Duct leakage testing confirming compliance with tests required for ducts over 2 inches WG pressure class.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA 2005 - HVAC Duct Construction Standards - Metal and Flexible.
- B. Manufacturer Qualifications: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
- C. Installer Qualifications: Company specializing in performing the Work of this Section with minimum 5 years documented experience.
- D. Regulatory Requirements: Construct ductwork to NFPA 90A and NFPA 96 standards.
- E. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests:
 - 1. All ducts over 2 inches WG pressure class shall meet requirements of seal class A in Section 1 of SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. All ducts 2 inches w.g. pressure class or less shall meet requirements of seal class C.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 016000 - Product Requirements: Transport, handle, store, and protect Products.
- B. Protect dampers from damage to operating linkages and blades.
- C. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- D. Store and handle sealant and fire-stopping materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 Sheet metal work as shown on plans is schematic and is based on the specified manufacturer's equipment and material dimensions. Contractor shall make accurate measurements in the field prior to duct work fabrication and shall provide all necessary offsets and transition pieces required to accommodate actual structural and equipment variations.

1.8 The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the

layout or configuration of the duct system must be specifically approved in writing to the Engineer.

- 1.9 At contractor's option, round duct may be substituted for rectangular construction and vice versa. Equivalent round duct sizes shall be in accordance with ASHRAE Fundamentals 2009, Chapter 21, Table 2. Contractor shall be responsible for coordination with other trades and any subsequent costs incurred by others for substituting round and rectangular ductwork.
- 1.10 Rectangular sheet metal duct dimensions are free area dimensions. Bottom of duct elevations, where indicated, are to the bottom of duct reinforcing angles or other components.
- 1.11 Round duct dimensions are inside, free area dimensions.
- 1.12 The work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.
- 1.13 Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 - A. Exhaust Ducts on Discharge of an Exhaust Fan to building exterior: 2 inch water gauge.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Supply, return, outside air, and relief air ductwork for HVAC systems, Exhaust ductwork (except where otherwise indicated below), and Supply ductwork to kitchen hood systems shall be constructed of:
 - 1. Galvanized Sheet Steel, Lock-Forming Quality, Coating Designation G 90.
 - 2. Provide mill phosphatized finish for ducts exposed to view that are to be painted.
 - 3. Reinforcement, Support, Hanger, and Trapeze Shapes and Plates:
 - a. ASTM A 36/A 36M, steel plates, shapes, and bars. Unless otherwise indicated, provide galvanized finish of fabricated plates, shapes, and bars or provide fabricated plates, shapes, and bars of the same material as the sheet metal ducts.
 - b. Strut-Channels: Duct reinforcements, supports, and trapeze hangers may alternatively be a bolted metal framing system equal to B-Line. The system shall be channels, fittings and hardware as defined and tested in accordance with the Metal Framing Manufacturers Association Standard Publication MFMA.
 - 1) Channels shall be hot dip galvanized after fabrication and made from steel meeting ASTM A570, Grade 33. Hot dip galvanizing after fabrication shall be in accordance with ASTM A123.
 - c. Where the galvanic index of the reinforcements, supports, hangers, or trapeze and the duct materials is greater than 0.15 volts (galvanized-steel plates, shapes, bars, or struts are used to reinforce aluminum or stainless steel ducts), isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- B. All materials used shall meet the requirements of NFPA 90A and UL 181 for Class I air ductwork.

C. Minimum Sheet Metal Gauges for Ductwork:

1. Rectangular ductwork shall be fabricated from the following minimum thicknesses, regardless of duct construction methods, for sizes indicated:

Max. Long Side Dimension	Steel Gauge
0-12 inches	26
13-30 inches	24
31-54 inches	22
55-84 inches	20
85 inches and above	18

2. Round ductwork shall be fabricated from the following minimum gauges for sizes indicated: (Round ductwork shall not be allowed for ducts over 84".)

Max. Long Side Dimension	Steel Gauge
2-12 inches	26
13-21 inches	24
22-35 inches	22
36-49 inches	20
50-59 inches	18
60-84 inches	16

3. Minimum gauges for stainless steel shall be the same as listed for steel.
4. Minimum thickness and reinforcement for aluminum shall be as indicated in SMACNA 2005 Table 2-50, 2-51 and 2-52 for rectangular - ducts and 3-14, 2-51, and 2-52 for round ducts.

D. Sealants:

1. Joint and Seam Sealant: One-part, nonsag, water based, vinyl acrylic sealant complying with ASTM C-731 and D-2202, rated for indoor and outdoor use, viscosity greater than 350,000 c.p.s, rated per ASTM E-84 with flame spread and smoke developed ratings of 0, formulated with a minimum of 63 percent solids. Carlisle - Hardcast Iron Grip IG-601 or equal.
2. Flanged Joint Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10. Ductmate 5511M for attaching flanges to ducts, Ductmate 440 tape for flange to flange joints, or approved equal.
3. Isolation Gaskets: Butyl rubber, neoprene, silicone rubber, or EPDM polymer with polyisobutylene plasticizer. Rated per ASTM E-84 with maximum flame spread and smoke developed ratings of 10.
4. Slip On Flange Joint Mastic: Non-drying, non-skinning, polymer base, pumpable sealant. ASTM E-84 with maximum flame spread and smoke developed ratings of 5. Ductmate 5511M for attaching slip on flanges to ducts or approved equal.

5. Fire-Resistant Sealants for filling openings around duct penetrations through walls and floors shall be as specified in Section 230010, Basic Mechanical Materials and Methods.
6. General Sealant: One-part, acid-curing, Silicone, elastomeric joint sealant, complying with ASTM C 920, Type S (single component), Grade NS (nonsag), Class 25, Use O. Provide one of the following:
 - a. Chem-Calk 1200; Bostik Inc.
 - b. 999-A; Dow Corning.
 - c. Construction 1200 or Contractors SCS1000 or SCS1702F; GE Silicones.
 - d. HiFlex 392 or NuFlex 302; NUCO Industries, Inc.
 - e. HM 270; Ohio Sealants, Inc.
 - f. 860 or 863; Pecora Corporation.
 - g. Tremsil 300; Tremco.

E. Acoustical Joint Sealants:

1. Applications: Seal joints in drywall sound enclosures as indicated on the sound enclosure details.
2. Acoustical Sealant for Exposed and Concealed Joints: Provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product shall effectively reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Products: Provide one of the following:
 - a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
 - b. BA-98; Pecora Corporation.
3. Acoustical Sealant for Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission. Provide one of the following:
 - a. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.
 - b. Pro-Series SC-170 Rubber Base Sound Sealant; Ohio Sealants, Inc.
 - c. Tremco Acoustical Sealant; Tremco.

2.2 SINGLE WALL RECTANGULAR DUCT FABRICATION

- A. Fabricate rectangular ducts in accordance with SMACNA 2005 Tables 2-1 through 2-48, including their associated details, and the Model Specifications shown in SMACNA 2005, except where this specification requires otherwise. Conform to the requirements in the referenced standard for metal thickness (except comply with minimum gages show above), reinforcing types and intervals, tie rod applications, and joint types and intervals.
- B. All reinforcements between transverse joints for duct dimension greater than 36 inches shall extend past the edge of the duct and be secured with an approved tie rod or tie angle as generally shown in SMACNA 2005 Figure 2-12 for "tie alternatives for two side reinforcements".

- C. All longitudinal seams shall be made with a Pittsburgh lock or a grooved seam. Fabricate transverse joints for all ducts with height or width 48 inches or greater with T-24, T-25, or Ductmate duct connections (or approved equal).
- D. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- E. Where Ductmate (or equal) joints are used, they shall be rated as reinforcing class "F" for Ductmate 25, reinforcing class "G" for Ductmate 35, or reinforcing class "H" for Ductmate 45 and integrated with the requirements of SMACNA Tables 2-1 through 2-28. Similar tables from Ductmate Industries shall not be substituted for the SMACNA 2005 tables. Ductmate joints shall be installed in compliance with the manufacturer's recommendations.
- F. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- G. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA 2005 Figure 2-9, unless they are lined or are externally insulated.
- H. Tie Rods:
 - 1. Internal tie rods shall be allowed for ducts 36" wide and wider. Midpanel tie rods shall be allowed for ducts 36" wide through 96" wide.
 - a. Internal tie rods and midpanel ties shall not be allowed:
 - 1) Within 20 feet of a fan discharge or fan inlet.
 - 2) In kitchen hood exhaust ducts.
 - 3) In Fume exhaust ducts.
 - 4) In underground, in-slab, or under slab ducts.
 - 5) In fittings with non-parallel sides unless they have load distributing means such as wedges.
 - 6) In ducts with duct liner.
 - 7) For oval ducts, aluminum ducts or polyvinyl coated steel ducts, unless otherwise noted on the drawings.
 - 2. The maximum internal tie rod diameter shall be 3/4"; straps used for tie rods shall be maximum 1/8" thick and shall be installed with the thickness facing the air flow; angles or other structural shapes shall not be used for internal tie rods. Tie rods shall be attached to ducts in accordance with SMACNA 2005, Figures 2-5 and 2-6.
 - 3. Threaded inserts placed in pipes, tubes and conduits shall be secure for 200% of the loads indicated in SMACNA 2005, Table 2-34.
 - 4. Where internal ties occur in two directions, they shall be either prevented from contacting or be permanently fastened together.
- I. Singular Wall Rectangular Duct Fittings:

1. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA 2005 Figures 4-1 through 4-9 and 7-1 through 7-4.
2. All rectangular duct elbows shall be radiused in accordance with SMACNA Figure 4.2 type RE-1 (centerline radius equal to 1.5 x W) unless otherwise indicated.
 - a. Other Fitting Types:
 - 1) Provide radius elbows with vanes, Figure 4.2 Type RE-3, where indicated and in accordance with details shown; minimum inner radius shall be equal to 0.5 x W unless otherwise shown; two (2) or three (3) internal vanes shall be provided as indicated on the drawings per Figure 4-9 and spaced per Chart 4-1.
 - 2) Rectangular square throat duct elbows shall be provided only where indicated and shall:
 - a) Provide single thickness, 4.5" radius turning vanes for vane lengths up to 36 inches and double thickness, in accordance with SMACNA Figure 4-2 Type RE-2 and Figure 4.3. Spot weld vanes to end runners and screw runners to elbow cheeks with screws on 8 inch centers. Support vanes per SMACNA Figure 4-4.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials and local authority having jurisdiction.
 1. Powder actuated fasteners shall not be allowed where the piping, ductwork or equipment is required to meet seismic bracing requirements in Section 230020 or the Building Code and unless the powder actuated fasteners are rated for these seismic loads. Powder actuated fasteners shall not be allowed in tension applications for Seismic Design Category D, E or F (as defined by the International Building Code).
 2. Do not use powder actuated concrete fasteners unless approved by the Engineer in writing.
- B. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.
- C. Upper attachments shall be as indicated in SMACNA 2005 Figures 5-1 through 5-4.
 1. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 2. Structural Attachments shall be B-Line, Unistrut, Grinnel, or approved equal:

Beam clamps:	B 3031, B 3033, B 3034, B 3050, B 3045
Angle Iron Beam Clamp:	B 3046
Bar Joist:	B 3059
Concrete Inserts:	B 3500, B 2505 thru 2508, or B 3014
Drilled Inserts:	Phillips Red-head, wedge anchors or equal.

D. Hangers:

1. Strap and band hangers shall be fabricated of the same material as the sheet metal ducts.
2. Hanger sizes shall be as indicated in SMACNA 2005 Tables 5-1 and 5-2 for sheet steel width and gauge and steel rod diameters.
3. Rod hangers shall be fabricated of round, cadmium-plated threaded steel rods and nuts.
 - a. Rod hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - b. Hanger rods shall be threaded both ends, threaded one end, or continuously threaded.
4. Seismic sway bracing shall be in accordance with Section 230020.
 - a. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Steel Cables for Stainless-Steel or Aluminum Ducts: Stainless steel complying with ASTM A 492.
 - c. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Lower Attachments:

1. Duct attachments shall be sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
2. Lower attachment shall be as indicated in SMACNA 2005 Figure 5-5.

F. Trapeze and Riser Supports:

1. Trapeze sizes shall be as indicated in SMACNA 2005 Tables 5-3 and 5-4 and Figure 5-6 and 5-8 through 5-10.
2. Where trapeze or riser supports are a different material than the sheet metal duct, a minimum 1/16 inch thick isolation gasket shall be provided between the duct and the support.

2.4 FLEXIBLE CONNECTORS

- A. Flexible connectors installed inside the building shall be heavy glass fabric, double coated with neoprene, of approximately 30 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall be "Ventfab" by Ventfabrics, Inc. or equal.
- B. Flexible connectors installed outside the building shall be heavy glass fabric, double coated with neoprene, of approximately 26 oz. per square yard, provided with 3" wide, 24 ga. metal mounting strips firmly attached to each edge. Connectors shall be suitable for pressure class of the air handling system. Flexible connectors shall be Ventlong Hypalon by Ventfabrics, Inc. or equal.

2.5 External Duct Insulation: See Section 230200 - Mechanical Insulation.

2.6 FIRE DAMPERS

A. General

1. Fire dampers in ducts connected to a fan shall be the UL labeled, dynamic rated fire dampers unless otherwise indicated on the plans. Fire dampers in transfer ducts not connected to a fan shall be the UL labeled, static rated fire dampers unless otherwise indicated on the plans. Dampers shall be the curtain type, except where the size is too large they shall be multi-blade type, unless otherwise indicated on the drawings.
2. Fire dampers shall be constructed and tested in accordance with UL Standard 555. Each damper shall have a 165 degrees F fusible link (see plans for dampers with link rating of 212 or 280 degrees F).
3. Dampers shall have Ductmate breakaway connections where either the height or width of the connecting duct is 48" or greater.
4. When the wall or floor opening exceeds the dampers maximum UL listed multiple section assembly size, provide mullions manufactured by the damper manufacturer where so approved by their UL rating.
5. Provide factory installed sleeves for fire dampers. Sleeves shall be the same thickness as the adjacent duct, or the minimum thickness required by governing code, but not less than the following:

Max. Long Side of Duct or Diameter	Steel Gauge
0-12 inches	26
13-30 inches	24
31-54 inches	22
55-84 inches	20
85 inches and above	18

6. Provide access doors to allow resetting of fire damper and replacement of the link.
7. Fire dampers shall be manufactured by Ruskin, Air Balance, Pacific, Phillips, Prefco, Nailor, Greenheck, or Airstream.

B. Curtain Type Fire Dampers

1. Curtain type fire dampers shall be type B (type C for round ducts) unless otherwise indicated on the drawings.
2. Curtain type dampers shall be gravity operated for vertical installations; dampers in a horizontal position shall have stainless steel closure spring and blade lock. Fire dampers shall be equipped for vertical or horizontal installation as required by the location indicated.
3. Curtain type fire damper pressure drop shall not exceed the following:

VEL (FPM)	P.D. (W.C.)
1000	0.01

1500	0.015
2000	0.07
3000	0.15

- C. Curtain type dampers shall be Ruskin model DIBD2 (1-1/2 hour) and DIBD23 (3 hour) for dynamic type and IBD2 (1-1/2 hour) and IBD23 (3 hour) for static type unless otherwise indicated on the plans. Multi-blade type dampers shall be Ruskin model FD-60 (1-1/2 hour) and FD-31 (3 hour) unless otherwise indicated on the plans.

2.7 BACK DRAFT DAMPERS

- A. Back draft dampers shall comply with the following:
1. Shall have minimum 2", 0.125" thick extruded aluminum frame reinforced for rigidity.
 2. Aluminum blades of maximum 6" width.
 3. Adjustable counterweight.
 4. Cadmium plated steel shafts.
 5. Blade shafts shall operate in ball bearings.
 6. Hardware shall be cadmium plated steel with brass pins.
 7. Dampers shall include blade edge seals. Leakage shall be less than 12 cfm per sq. ft. at ½ inch W.G.
 8. Use multiple damper sections for sizes above 48" x 48".
- B. Back draft dampers shall be Ruskin model BD-6 or approved equal by NCA, Greenheck, or Nailor.

2.8 ACCESS DOORS

- A. Access doors for ductwork shall be minimum 22 gauge galvanized steel with a continuous piano type hinge and camlock(s) (1 for doors 16" and 2 for larger doors); air leakage shall not exceed 0.21 CFM per square foot at 1 inch static pressure. Doors shall be 24" x 24", except for small ducts, where doors shall be as large as practical. Doors shall include a seal between the door and frame and shall also include a seal between the frame and duct. Doors shall be Ruskin model ADH 12 or equal by Cesco Products (Minneapolis, Mn.), A.J Manufacturing, or approved equal.

PART 3 - EXECUTION

3.1 HANGING AND SUPPORTING DUCT WORK

- A. All ductwork shall be neatly supported and properly anchored to building construction so horizontal ducts are without sag or sway, vertical are without buckle and all are free from the possibility of deformation collapse or vibration.
- B. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA 2005 Tables 4-1 through 4-3 and Figures 4-1 through 4-9.
- C. Install single wall ductwork except where double wall ducts are indicated on the plans.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection. Provide trapeze hanger diagonally under all elbows greater than 54 inches wide.

- E. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load.
- F. Hanger rods shall have double nuts and lock washers at all connections.
- G. Install concrete inserts prior to placing concrete.
- H. Install drilled inserts and powder actuated concrete fasteners after concrete is placed and completely cured. Obtain approval of the Engineer prior to using powder actuated concrete fasteners.
- I. Duct shall not be supported from metal roof deck.

3.2 DUCT INSTALLATION, GENERAL

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Verify exact locations and space requirements of ducts at the site and coordinate work with other trades, before fabricating ductwork.
- C. Install ducts with the fewest possible joints.
- D. Use fabricated fittings for all changes in directions, changes in size and shape, and connections. Provide all drops, raises, transitions, or offsets as required, at no additional cost to the Owner, Architect or Engineer, due to obstructions. When additional offsets, etc., different from those shown are required, approval shall be obtained from the Engineer prior to proceeding. All size or shape transitions shall be made gradually with angle not to exceed 15 degrees on each side.
- E. Install branch take-offs tight to duct wall with projections into main duct kept to a minimum. Ragged edges projecting into the main duct shall not be allowed.
- F. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. The sheet metal work shall be coordinated with that of other trades in such a manner that when the installation is complete, all items are properly installed and are serviceable.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- J. Coordinate layout with ceiling, lighting layouts, sprinklers and other piping.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with escutcheon of sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 2 inches.
- M. Branch Connections: Comply with SMACNA 2005 Figures 4-5 and 4-6.
 - 1. Install radius elbows and vaned elbows where shown on the plans. Radius elbows may be substituted for vaned elbows, but vaned elbows shall not be substituted for radius type unless approved in writing by the Engineer. 45 degree taps and other taps shall not be substituted for elbows.
- N. Outlet and Inlet Connections: Comply with SMACNA 2005 Figures 7-6, 7-7 and 10-1 and as indicated on plans.
- O. Flexible Connections at Fans: Comply with SMACNA 2005 Figure 7-8.
- P. Provide openings in ductwork where required to accommodate thermometers and temperature sensors.
- Q. Clean duct system and force high velocity air through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.
- R. During construction all open ends of installed ductwork shall be kept covered to prevent dirt and debris from entering ducts. Openings shall be covered with plastic sheeting held in place with duct tape or utilize Dyn-O-Wrap DW/PRW/RPRW or equivalent. Any ducts stored on site shall be protected by keeping them raised off the ground.
- S. Ducts shall be neatly finished on the outside with all sharp edges removed. Inside surfaces shall be smooth with no projections into the air stream.
- T. All fasteners and attachments shall be made of the same material as the ducts or of corrosion-resistant material.
- U. Ducts up through 2" pressure class shall have all transverse duct joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class C. Ducts over 2" pressure class shall have transverse and longitudinal joints sealed in compliance with the sealant manufacturer's recommendations and SMACNA procedures for Seal Class A.
- V. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance. Dissimilar metals shall be connected with flanged joints made up with neoprene gaskets to prevent contact between metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same material as the gaskets.
- W. Where dampers are installed in ducts having external duct insulation, install damper locking quadrants with hat channel or of same depth as insulation to allow smooth operation of dampers.

- X. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

3.3 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Provide hanging materials that match the appearance of the exposed ducts.
- C. Remove any identification labels or markings from ducts so appearance of ducts at such locations matches the remainder of the ducts.
- D. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- E. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- F. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- G. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 LEAKAGE TESTING

- A. Ducts, plenums, and casings shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry. The term, "substantially airtight," shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing.

3.5 DUCT CLEANING

- A. Clean new duct system(s) to remove oil film and dust before testing, adjusting, and balancing.

3.6 SEISMIC RESTRAINT INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces. Comply with requirements of Section 230020, Vibration and Seismic Controls for HVAC Piping and Equipment.
- B. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c. unless otherwise indicated.
- C. Brace a change of direction longer than 12 feet.
- D. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- E. Install cables so they do not bend across edges of adjacent equipment or building structure.

- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 FIRE DAMPER INSTALLATION

- A. Damper installation shall be in compliance with NFPA #90A, UL requirements and manufacturer's installation instructions.
- B. Fire dampers shall be installed in all ducts and openings through fire rated partitions, ceilings and floors, where required by Code, and where indicated on plans.
- C. Minimum fire damper width shall be 12" unless otherwise indicated. Provide duct transition if necessary to achieve the minimum width. Provide an access door in the duct and/or an access panel in the wall or ceiling to allow resetting the damper. All dampers must be installed so the fusible link is accessible.
- D. Provide 1-1/2 and 3 hour rated fire dampers at locations shown on the drawings or as required by governing codes.

3.8 BACK DRAFT DAMPER INSTALLATION

- A. Back draft dampers shall be installed on exhaust fans where scheduled and other locations where indicated on drawings.

3.9 MOTORIZED DAMPER INSTALLATION

- A. Coordinate with Section 230960 for actuator requirements.
- B. Install motorized dampers per manufacturer's instructions.
- C. Actuators shall be installed on the outside of ducts unless otherwise indicated. Provide access doors where damper motors are concealed in ducts.
- D. Install damper control devices on stand-offs where required to allow complete coverage of insulation.

3.10 ACCESS DOOR INSTALLATION

- A. Provide access doors in ducts at fire dampers, where actuators for motorized dampers are concealed inside ducts, and at other items located in ducts or plenums where access into ductwork is required for maintenance or installation of work by other trades.

3.11 TEST OPENING INSTALLATION

- A. Provide test openings in ductwork for testing and balancing.
- B. Patch insulation, ductwork, and housings, using materials identical to those removed.
- C. "Plastic Plugs" may be used to seal openings where duct traverses are made.
- D. Provide Pitot tube openings where required for testing of systems. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

END OF SECTION 230900

SECTION 230910 – START-UP, CLEANING AND TESTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, services, materials and related items necessary to complete the start-up, cleaning and testing work indicated on the drawings and/or specified herein. Work to be performed shall include, but not be limited to, the following items:
 - 1. Hot Water System
 - 2. Hot / Chilled Water System Dual Temperature
 - 3. Condensate Drains

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - General Mechanical Conditions.

PART 2 - PRODUCTS

2.1 PIPE CLEANING CHEMICALS

- A. Vulcan Precleaner or approved equal by Nalco or Calgon.

PART 3 - EXECUTION

3.1 START-UP OF SYSTEMS AND EQUIPMENT

- A. Before any systems, or parts of systems are placed into unattended operation, they shall be completely installed, pressure tested, cleaned, flushed and balanced with all operating and safety controllers installed, calibrated and operational.
- B. When started, all motors shall be checked for proper rotation, speed, and amperage. If overloading is indicated, immediate corrective measures shall be taken to prevent damage to the motor.
- C. Before systems are operated, all bearings shall be lubricated and all other liquid levels and pressures checked and if necessary corrected.
- D. Contractor shall start-up all systems and equipment and place all systems into operation. Any equipment, pieces of equipment, controls, etc., damaged or not operating properly shall be replaced at this contractor's expense.
- E. Contractor shall verify proper and safe operation of all equipment, components, controls and control circuits before any system is left unattended.

- F. Whenever air systems are operated, air filters shall be in place. Air systems shall not be operated at any time without filters.

3.2 PIPE SYSTEMS TESTING

- A. Except for those pipes hereinafter listed, all piping installed by this Contractor shall be pressure tested. (See Plumbing Section for testing of plumbing piping.)
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure as indicated below and that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. Prepare written report of testing.
- C. Perform the following tests on refrigerant piping:
 - 1. See test requirements in Section 230150 "Refrigerant Piping."
- D. The following pipes do not require a pressure test:
 - 1. DX coil condensate drains.
- E. Any item which might be damaged by the pressure test shall be removed from the system during the test, or isolated from the test.
- F. Gauges used for testing shall be tested for accuracy, and then installed as close as possible to the low point of the system to be checked.
- G. For hydronic piping, test pressure shall be maintained for 24 hours. Initial and final test pressures and ambient temperatures shall be recorded. Test pressure and ambient temperature shall also be recorded on 2 hour intervals during the daytime work shift. All tests shall be witnessed and signed by the Owner's Representative. When test is complete, recorded data shall be submitted to this Engineer. Any tests which are not witnessed shall be considered void and pipes shall be retested.
- H. No leakage is permitted. Leaks shall be repaired and the lines retested.
- I. Any lines changed after testing shall be retested.

- J. Test data shall be recorded on a standard form.
- K. While piping is under test, care shall be taken that excessive pressure does not occur due to increase of ambient temperature.
- L. Test Pressure and Medium:

LINE SERVICE	MEDIUM	TEST PRESSURE PSIG
Heating Hot Water	Water	125
Chilled Water	Water	125
Refrigerant Relief Piping	Dry Nitrogen	200

3.3 CLEANING

- A. Adequate precautions shall be taken during storage and installation to keep the inside of all pipes, valves and fittings free from foreign materials.
- B. The inside of all pipes, valves, and fittings shall be smooth, clean, free from blister, loose mill scale, sand, dirt and other foreign material.
- C. This Contractor shall clean all piping installed by him.
- D. Closed, recirculating water systems (chilled water, heating hot water, etc.) shall be filled with clean water and flushed. The systems shall then be refilled with clean water to which 5 lbs. of Vulcan pre-cleaner, or approved equal, per 100 gallons of water has been added. System shall be allowed to recirculate for 8 hours and then drained and flushed with clean water. Any components which might be damaged by the cleaner shall be isolated or removed from the system. Vulcan Laboratories, or other approved cleaner manufacturer, shall supervise the cleaning and shall submit to the Owner a certificate of completion of cleaning. After cleaning, all strainers shall be cleaned. Systems which connect to existing systems shall have temporary bypasses or temporary pumping installed, whichever is applicable to allow cleaning of the system as described above before it is connected to the existing system.

3.4 TURN OVER TO OWNER

- A. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set temperature controls so all coils are calling for full flow.
 - 4. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
- B. When the system is turned over to the Owner, all systems shall have been started, tested, balanced and checked and proven to be fully operational in every respect.

- C. When the system is turned over to the Owner, all bearings shall have been recently lubricated, oil levels checked and oil added if necessary, liquid levels and pressures checked and corrected, flow rates checked and corrected, R.P.M.'s verified, belts tightened and aligned, and all controls and control sequences checked, verified operational and if necessary, corrected.
- D. When the system is turned over to the Owner, all air filters shall be replaced with clean filters.

END OF SECTION 230910

SECTION 230930 – TESTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, services, materials and related items necessary to complete the testing and balancing (TAB) work indicated on the drawings and/or specified herein. The scope of work shall include:
 - 1. Balancing of all air movement systems.
 - 2. Balancing of all hydronic systems.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 230000 - Mechanical General Conditions.
- C. Section 230010 - Mechanical Basic Materials and Methods.
- D. Section 230020 - Vibration Isolation and Seismic Restraints.

1.3 All instruments used by this agency shall be accurately calibrated and maintained in good working order.

1.4 The balance work shall be performed by an AABC (Associated Air Balance Council) or a NEBB (National Environmental Balance Bureau) certified firm. All work shall be done in compliance with the standards of the certification. All balance work shall be done under direct supervision of a qualified heating and ventilating engineer employed by them. All work shall also comply with the ASHRAE Standard 111 recommendations pertaining to measurements, instruments, testing, adjusting and balancing.

1.5 The balance firm shall have a minimum of 5 year's experience balancing similar systems.

1.6 If requested, the tests shall be conducted in the presence of the Engineer or their representative.

1.7 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.
- C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.8 SUBMITTAL

- A. Provide submittals under provisions of Section 230000.
- B. Within 30 days of award of the contract, submit:

1. Name and qualifications of testing, adjusting and balancing agency for approval by the Engineer.
 2. Submit sample balance report forms and detailed procedures for approval by the Engineer.
 3. Forms shall be representative for all the tests. Formulas and data to be used for determining heat exchange capacities, where required, shall be included.
- C. Submit 3 bound copies of draft report for review prior to final acceptance of Project.
- D. Submit 5 bound copies of final reports to the Engineer for inclusion in operating and maintenance manuals.
- E. Provide reports in soft cover, letter size, multi-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. Reports shall include the following information:
1. TAB Company name, address, and telephone number.
 2. Project name, location, Project Architect, Project Engineer, and Project Contractor.
 3. Project altitude.
 4. Instrument List:
 - a. Instrument.
 - b. Manufacturer.
 - c. Model.
 - d. Serial number.
 - e. Range.
 - f. Calibration date.

1.9 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years documented experience. Perform work under supervision of AABC Certified Test and Balance Engineer.
- B. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

1.10 SCHEDULE

- A. Sequence work to commence after completion of systems. Schedule completion of TAB work before Substantial Completion of Project.
- B. Draft air and water balance reports shall be submitted a minimum of 5 days prior to substantial completion.

1.11 PREPARATION FOR TESTING AND BALANCING

- A. The Mechanical Contractor shall bring the work to a state of readiness for testing and balancing all equipment and systems by doing the following:
 - 1. Verify lubrication of all equipment.
 - 2. Permanent instrumentation to be operational.
 - 3. Check rotation and alignment of rotating equipment and tension of belt drives.
 - 4. "Start-up" HVAC equipment and continue operating the equipment during the testing and balancing.
 - 5. Verify rating of overload heaters in motor starters.
 - 6. Set control points of automatic controls and check calibrations and adjustments.
 - 7. Repair or replace at this contractor's expense components of system which do not function properly.
- B. Mechanical Contractor shall assist the balance firm as follows:
 - 1. Provide TAB firm with copy of the HVAC plans, specifications and approved equipment submittals.
 - 2. Change, at the Mechanical Contractor's expense, pulleys, belts, drive, etc., required to obtain correct air balance.
 - 3. Add, at the Mechanical Contractor's expense, dampers and/or valves as required by the TAB firm to correctly balance the HVAC systems.
 - 4. Repair duct leaks identified by the TAB firm.
 - 5. Put all HVAC equipment and systems into operation and continue the operation during each working day of TAB, as required.
 - 6. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.
 - 7. Provide temperature and pressure taps according to the Construction Documents for TAB testing.

1.12 DEMONSTRATION

- A. Demonstrate as follows:
 - 1. The TAB Firm shall be prepared to demonstrate to the Engineer and the Owner that actual conditions match the balancing report. At the Engineer's discretion:
 - a. Retest no more than 30% of the supply, return and exhaust outlets to demonstrate that they are reading what the balance report indicates.
 - b. Retest no more than 30% fan/pump, etc., systems to demonstrate that they are operating at conditions indicated in the balancing report.
 - c. Retest no more than 30% of controls relative to the mechanical equipment to demonstrate that they are operating properly.
 - d. Retesting shall be done in cooperation with the Engineer and the Owner's personnel and in their presence if requested.

PART 2 - PRODUCTS

2.1 MEASUREMENTS AND INSTRUMENTATION

TESTING AND BALANCING

230930 - 3

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.
- J. Prepare and submit a profile of the air flow across all coils in all air handling units.

PART 3 - EXECUTION

3.1 The TAB firm shall provide the following services:

- A. Test and balance the air distribution and exhaust system to within 10% of design conditions in accordance with the following:
 - 1. Measure and record the following initial and final fan data for each rooftop unit and exhaust fan: fan total static pressure, fan RPM, fan motor current and total CFM.
 - 2. Make adjustments in fan RPM as required to obtain the required total CFM, outside air CFM and return air CFM.
 - 3. For variable-air-volume systems, compensate for diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 - a. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, select the terminal unit that is most critical to the supply-fan airflow and static pressure and adjust system static pressure so the entering static

pressure for the critical terminal unit is the minimum that will allow this unit to operate properly as recommended by the terminal-unit manufacturer.

4. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
 5. Adjust balance dampers as necessary for design air flow from each diffuser and to each exhaust and return grille. Use volume control devices on air devices to regulate air quantities only to extent that adjustments do not create objectionable sound levels. Effect volume control by duct mounted dampers. Report required CFM and resultant CFM after final adjustments. Report percent of design air flow.
 6. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts and install test ports.
 7. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
 8. Adjust deflection vanes on all air devices as indicated on plans and schedules and to minimize drafts in all areas. Adjust return air devices to block line of sight into return air duct or plenums.
 9. Examine HVAC equipment with functioning controls is ready for operation and terminal units, such as variable-air-volume boxes, are accessible and their controls are connected and functioning.
- B. Test and balance the hydronic system to within 10% of design conditions accordance with the following:
1. Measure and record the following initial and final pump data: shutoff head, operating head, motor current and total GPM.
 2. Adjust the pump discharge balancing valve as required to obtain design GPM.
 3. Measure and adjust flow through all elements to obtain the design GPM.
 4. Adjust the balancing valve in the bypass lines to obtain the same pressure loss when the control valve is in the full flow or bypass position.
 5. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
 6. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

7. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
 8. For variable-flow hydronic systems, balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals.
 - a. Compensating for Diversity: When the total flow of all terminal units is more than the indicated flow of the pump, place a selected number of terminal units at a minimum set-point flow with the remainder at maximum flow condition until the total flow of the terminal units equals the indicated flow of the pump. Select the reduced flow terminal units so they are distributed evenly among the branch piping.
 9. For primary-secondary hydronic systems, balance the primary circuit flow first and then balance the secondary circuits.
- C. Test and balance the control system and make temperature tests in accordance with the following:
1. In cooperation with the control contractor, check all devices in the control system for function and calibration.
 2. Measure temperatures (EAT and LAT as applicable) at all rooftop units, coils, etc. when this equipment is operating under maximum load or conditions similar to maximum load for both heating and cooling.
- D. Motor rotation and speed shall be checked and recorded for all motors.
- E. Proper air flows shall be demonstrated in minimum outside air, full outside air (economizer), and intermediate positions. Intermediate positions shall be carefully observed to insure that no overloading or other objectionable conditions occur. Should any objectionable conditions occur, the Engineer shall be notified of the conditions and their causes.
- F. Submit reports of discrepancies, deficient or uncompleted work by others to the GC and Owners Rep at least once a week prior to submitting a draft test and balance report.
- G. Submit draft test and balance reports. Coordinate with Engineer and MC to resolve deficiencies.
- H. Submit final test and balance reports when deficiencies have been resolved.
1. Upon completion of the remodeling work, the supply air system shall be proportionately balanced to the air quantities shown on the drawings. Supply and return fan speeds are to be initially adjusted using the existing variable frequency drives. The supply air fan shall be set to run at the same minimum speed necessary to maintain the same static pressure in the supply ductwork as measured before the system was modified. Following approval by the Engineer, the fans shall be re-sheaved to achieve the scheduled airflow.

I. Hydronic Systems

1. Where indicated on the plans, a water flow measurement shall be made to verify existing flows in the system. If a flow measuring device is not installed at these locations, measure inlet and outlet pressures at the indicated coils or pumps to verify the pressure drop at these devices.

END OF SECTION 230930

SECTION 230960 – TEMPERATURE CONTROLS

PART 1 - GENERAL

- 1.1 This Contractor shall furnish and install a complete system of temperature controls. This system shall include all controllers, thermostats, control devices, wiring, etc., required to accomplish the sequence hereinafter described.
- 1.2 All power wiring shall be in conduit and shall meet the latest edition of NEC. All control wiring shall have plenum rated insulation.
- 1.3 Related Documents
 - A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
 - B. Section 230000 - Mechanical General Conditions.
 - C. Section 230010 - Basic Materials and Methods.
 - D. Section 230020 - Vibration Isolation and Seismic Restraints.
 - E. Section 230930 - Testing and Balancing.
 - F. Division 26 - Fire Alarm System - Smoke Detectors.
- 1.4 SUBMITTALS
 - A. General
 - 1. Meet all applicable Submittal requirements of Division 1, Division 23, and the following including listed below.
 - 2. Provide to the Engineer all information or data necessary to determine compliance with these specifications.
 - 3. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements indicated.
 - 4. All Drawings and Diagrams shall be machine drafted using AutoCAD or Microsoft Visio. At project closeout, provide copy of control drawings and layout drawings.
 - 5. Provide system device and LAN conduit routing drawing, using building plans for a background. All controllers, gateways, hubs, devices and communication cabling shall be accurately shown, except that individual sensor I/O wiring and devices need not be shown. Layout drawings shall be the same size as the Engineer's construction documents.
 - B. Hardware - Include a complete list of materials of equipment to be used, including technical data, performance curves, project specification sheets and installation/ maintenance instructions.

- C. Control System Diagrams - Provide schematic diagrams for each controlled system. Illustrate the relationship between control system and controlled equipment. Show all control elements. Show all terminations and cable/tube numbers.
1. Provide equipment interface details using actual equipment termination information. Blank terminals or "field verify" is not acceptable.
 2. Provide individual diagrams for each mechanical system. If two systems are identical, then a single diagram may represent multiple mechanical systems. Notations like "this part here only applies to units xxx", etc. are not acceptable.
 3. The control diagrams and sequence of operation shall be together on the same sheet and shall be suitable for posting.
 4. The sequence of operation shall reference a schematic diagram of the controlled system. The sequence of operation shall describe in words the control strategies utilized, worded in such a way to serve as an informative reference to the maintenance and service personnel who will be responsible for unit operation.
 5. Each component and instrument on the control diagrams shall have a unique tag number such as temperature element "TE-1". The sequence of operation verbiage shall make specific reference to the individual component tag numbers, such as "Controller (C-1) compares the space temperature sensor (TE-1) to set point, and modulates hot water heating coil valve (V-1) as required". The mechanical system being controlled shall be schematically drawn and show the measurement and control points, such as "TE-1" and "V-1".
- D. Point List - Provide a point list for each system controller including both inputs and outputs (I/O) point, point number, the controlled device associated with the I/O point and the location of the I/O device. Use naming convention consistent with control diagrams and sequence of operation.
- E. Sequence of Operation Documentation shall be submitted indicating the designed procedures and processes to operate and maintain the system.
- F. Parts List shall be submitted listing: manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delay.
- G. Closeout Submittals
1. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
 - 2) Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.

- 3) As-built versions of submittal Product Data.
- 4) Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
- 5) Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
- 6) Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
- 7) Engineering, installation, and maintenance manuals that explain how to:
 - a) Design and install new points, panels, and other hardware.
 - b) Perform preventive maintenance and calibration.
 - c) Debug hardware problems.
 - d) Repair or replace hardware.
- 8) Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
- 9) Backup copy of graphic files, programs, and database on electronic media such as DVDs.
- 10) List of recommended spare parts with part numbers and suppliers.
- 11) Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- 12) Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
- 13) Licenses, guarantees, and warranty documents.
- 14) Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- 15) Owner training materials.

PART 2 - EXECUTION

2.1 DUCTLESS SPLIT SYTEM

- A. Install thermostat supplied with equipment.
- B. Interface unit BACnet connection and map pointer back to Hospital BAS. Create graphics on Hospital BAS for new ductless split.
 1. Pointer to be:
 - a. Space temperature and alarm if above setpoint Deadband.
 - b. Condensate overflow alarm.

- c. Fan on/off
- d. Unit on/off
- e. Heating and cooling

2.2 DRAIN PAN WATER SENSORS

- A. Install water sensors in Drain pans below piping sensors to alarm Hospital BAS. Create graphic showing pan and sensor and room number.

END OF SECTION 230960

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DIVISION 26

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SECTION 260060 – ELECTRICAL SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the electrical service from local utility.
- B. Service shall be as follows:
 - 1. Primary metered electrical service to medium voltage switchgear and pad mount transformers.

1.2 RELATED SECTIONS

- A. Refer to other sections for conductors, switchboards, and raceways, fittings and boxes.

1.3 UTILITY SERVICE

- A. Verify all details relative to the Utility Company's installation and termination requirements. Furnish and install all such material required by the Utility Company.
- B. The building service voltage shall be 12,470 Volts, 3 phase, 3wire.
- C. The Utility is Ameren

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PAD MOUNTED TRANSFORMER SERVICE

- A. Electrical Contractor shall:
 - 1. Furnish and install underground primary conduit from the switchgear pad to a location at the property line that is determined by the Utility. The conduit shall be 5" directional boring electrical conduit at a minimum depth of three (3) feet and shall contain a pull tape.
 - 2. The contractor shall provide the medium voltage switchgear, switchgear pad, transformers, transformer pads, The switchgear pad shall be a poured pad (at the site) and conform to the Utility specifications.
 - 3. Furnish and install the primary and secondary feeders from the switchgear to the pad-mount transformers and to the Main-Tie-Main switchboard.
 - 4. The medium voltage switchgear vendor shall furnish and install the CT/PTs, the metering section in switchgear, and the contractor shall provide conduit from the current transformers and potential transformers to the meter enclosure, as required by the utility.

5. Furnish and install meter ground (including conductors, rods and connections).

B. The Utility shall:

1. Furnish and install the primary cables in the contractor-provided underground primary conduit.
2. Provide the requirements for providing the current transformers, metering wire harness, and potential transformers to the switchgear vendor.
3. Furnish and install the meter.

END OF SECTION 260060

SECTION 260115 – UNDERGROUND DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section covers the installation of direct bury and concrete encased underground ducts.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 “National Electrical Code” for components and installation.
- B. Comply with IEEE C2 “National Electrical Safety Code” for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.
- D. Comply with NECA / NEMA 605, “Recommended Practice for Installing Underground Non-metallic Utility Duct.”

PART 2 - PRODUCTS

2.1 HIGH VOLTAGE POWER SYSTEMS (2.4KV AND ABOVE)

- A. Provide PVC Schedule 80 ducts, direct buried or concrete encased, as indicated on plans.

2.2 LOW VOLTAGE POWER SYSTEMS (600V OR LESS)

- A. Provide PVC Schedule 40 ducts, direct buried or concrete encased, as indicated on plans.

2.3 CONNECTORS AND COUPLINGS

- A. Provide proper connectors and couplings for the ducts per manufacturer’s recommendations.

2.4 CONCRETE

- A. 3000 psi minimum 28 day compressive strength. Comply with American Concrete Institute Publications.
- B. Concrete for high voltage ducts shall have dark red color tint throughout, or spread red coloring on top of concrete immediately after placement.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate all locations, size and details of this installation with the existing site conditions.

- B. Work with extreme care near existing ducts, conduits, cables and other utilities to avoid damaging them.

3.2 INSTALLATION

- A. Clearances between each conduit and/or duct shall not be less than 3 inches.
- B. Install concrete or plastic spacers to insure maintenance of the above clearances during concrete pours.
- C. Install tie wires to prevent displacement of the ducts and conduits during pouring of concrete. Do not use tie wires as substitutes for the spacers.
- D. Prior to installing cables in new and existing underground raceways, thoroughly clean the raceways with suitable mandrels or swabs.

3.3 TERMINATIONS

- A. Terminate the ducts and conduits with the proper manufactured end bells.
- B. Seal the ducts and conduits at building entrances and at outdoor terminations for equipment, including spare ducts and conduits, with a suitable compound to prevent the entrance of moisture and gases. Install Tyco Electronics "TDUX" or equivalent product in all conduits at building entrance.
- C. Where new ducts, conduits and concrete envelopes are to be joined to existing manholes, hand holes, ducts, conduits and concrete envelopes, make the joints with the proper fittings and fabricate the concrete envelopes to insure smooth, durable transitions.

3.4 TRENCHES

- A. Cut the trenches neatly and uniformly.
- B. Pitch the trenches uniformly without pockets, not less than 4 inches per 100 feet, toward manholes or both ways from high points between manholes. Avoid pitching the ducts toward buildings wherever possible.

3.5 CONCRETE WORK

- A. Concrete envelopes, when indicated, shall be as follows:
 - 1. Shall extend not less than 3 inches beyond the outside walls of the outer ducts and conduits.
 - 2. Top not less than 36 inches below finished grade.
- B. Pour concrete beds in the trenches, not less than 3 inches thick, and allow the concrete to set before placing the ducts or conduits.

END OF SECTION 260115

SECTION 260125 - MEDIUM VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes cables and related splices, terminations and accessories for 5KV-15KV electrical distribution systems.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Product data for cables and cable accessories, including splices and terminations.
 - 2. Product certificate signed by manufacturer that its products comply with the specified requirements.
 - 3. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners and other information specified.
 - 4. Product Test Reports: Certified reports of manufacturers' design and production tests indicating compliance of cable and accessories with referenced standards.
 - 5. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified. Include certified copies of field test records.
 - 6. Samples: 16-inch (400mm) lengths of each type of cable specified.
 - 7. Maintenance data for cables and accessories to include in the "Operating and Maintenance Manual"
 - a. Include recommended periodic tests of cables in service.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced and certified cable splicer to install, splice and terminate medium-voltage cable.
- B. Manufacturer Qualifications: Firm experienced in manufacturing medium-voltage cable and accessories similar to those indicated for this project, with a record of successful in-service performance.
- C. Comply with NFPA 70 "National Electrical Code" for components and installation.
- D. Comply with IEEE C2 "National Electrical Safety Code" for components and installation.

- E. Comply with NECA / NCSCB 600, "Standard for Installing and Maintaining Medium-Voltage Cable."
- F. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- G. Single-Source Responsibility: All medium-voltage cable shall be the product of a single manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver medium-voltage cable on factory reels conforming to NEMA WC 26.
- B. Store cables on reels on elevated platforms in a dry location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cables:
 - a. The Okonite Co.
 - b. Kerite
 - c. Prysmian
 - d. Southwire
 - e. Superior Essex
 - 2. Cable Splicing and Terminating Products and Accessories:
 - a. Cooper Power Systems, Inc., RTE Components.
 - b. Elastimold.
 - c. G&W Electric Co.
 - d. Energy Division, Raychem Corp.
 - e. 3-M Co.
 - f. Thomas and Betts Test

2.2 CABLES

- A. Type: MV105.
- B. Conductor: Copper.
- C. Conductor Stranding: Compact concentric round.
- D. Conductor Stranding: Class B.

- E. Insulation: 100% Ethylene Propylene Rubber (EPR) conforming to NEMA WC74 S-97-682 (ICEA S-93-639).
- F. Voltage Rating: 15 kV.
- G. Insulation Thickness: 133 percent insulation level.
- H. Shielding: Copper tape, helically applied over semiconducting insulation shield.
 - 1. Shielding: Solid copper wires, helically applied over semiconducting insulation shield.
 - 2. Shielding and Jacket: Corrugated copper drain wires embedded in extruded chlorinated polyethylene jacket.
- I. Jacket: Sunlight-resistant PVC meeting requirements of UL1072.

2.3 SPLICE KITS

- A. Connectors: IEEE 404, compression type, as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended in writing by the splicing kit manufacturer for the specific sizes, ratings and configurations of cable conductors and splices specified. Include all components required for complete splice, with detailed instructions.
 - 1. Combination tape and cold-shrink rubber sleeve kit with re-jacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
 - 2. Premolded ethylene propylene diene monomer (EPDM) splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.4 SOLID TERMINATIONS

- A. Multiconductor Cable Sheath Seals: Type recommended by the seal manufacturer for the type of cable and installation conditions, including orientation.
 - 1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.
 - 2. Heat-shrinkable sheath seal kit with phase and ground conductor re-jacketing tubes, cable end sealing boot and sealing plugs for unused ground wire openings in boot.
 - 3. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged 2-part epoxy resin casting material.
- B. Single Conductor Terminations: Comply with IEEE Standard 48, as indicated. Insulation class equivalent to that of the cable. Terminations for shielded cables include a shield grounding strap.
 - 1. Class 1 Termination for Shielded Cable: Modular type, furnished as a kit, with stress-relief tube, multiple molded silicone rubber insulator modules, shield ground strap and compression-type connector.

2.5 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: 10-mil (250-micron) -thick, corrosion-protective, moisture-resistant PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: NRTL-listed fireproofing tape, flexible, conformable, intumescent to 0.3 inch (8mm) thick and compatible with the cable jacket on which used.
- C. Glass Cloth Tape: Pressure-sensitive adhesive type, ½ inch (13mm) wide.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to NEMA WC 7 and NEMA WC 8 before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceway and pull box system to receive medium-voltage cables for compliance with installation tolerances and other conditions affecting performance of the cable. Check bending radii of raceway ells and other fittings for compliance with NEC requirements. Inspect space availability in switchgear termination compartments for adequate dimensional conditions for proper installation of termination and connection devices. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install medium-voltage cable as indicated, according to manufacturer's written instructions and IEEE 576.
- B. Pull conductors simultaneously where more than one cable is indicated in same raceway. Use NRTL-listed and manufacturer-approved pulling compound or lubricant where necessary. 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 raceways. Do not use rope hitches for pulling attachment to cable.
- D. Install exposed cable parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. In manholes, handholes pull boxes, junction boxes and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.
- F. Install splices at pull points and elsewhere as indicated using standard kit. Conform to kit manufacturer's written instructions.

- G. Install terminations at ends of conductors and seal multiconductor cable ends with standard kits. Conform to manufacturer's written instructions. Comply with classes of terminations indicated.
- H. Arc-Proofing: Arc-proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial or termination materials, except where indicated. Apply as follows and as recommended by the manufacturer of the arc-proofing tape.
 - 1. Clean cable sheath.
 - 2. Wrap metallic cable components with 10-mil (250-micron) pipe wrapping tape.
 - 3. Smooth surface contours with electrical insulation putty.
 - 4. Apply arc-proofing tape in one half-lapped layer with the coated side toward the cable.
 - 5. Band the arc-proofing tape with 1-inch (25mm) -wide bands of half-lapped adhesive glass-cloth tape 2 inches (50mm) on center.

3.3 GROUNDING

- A. Ground shields of shielded cable at terminations, splices and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware according to manufacturer's written instructions

3.4 FIELD QUALITY CONTROL

- A. Testing: Upon installation of medium-voltage cable and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.2. Certify compliance with test parameters.
 - 2. The cable shall have Very Low Frequency (VLF) Acceptance Test performed per IEEE 400.2-2013. Test fully assembled length up to (but not including) existing circuits or equipment. Test voltage used on new cable should be 21kV RMS at 0.1Hz per IEEE 400.2-Table 3. Written report shall be delivered to the engineer for review including all data and results or conclusions.
 - 3. Insulation ground wall test (Megger) at 5kV DC to be performed after all splices and terminations have been completed. Written report of result of test with resistance values shall be delivered to the engineer.
- B. Correct non-complying materials and devices at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new materials/devices and retest until acceptable results are obtained.

3.5 Commissioning

- A. All splices terminations, testing, grounding, and fire taping shall be completed prior to energizing the cable.

3.6 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer, to prevent entrance of moisture into the cable and ensure that medium-voltage cable is without damage or deterioration at Substantial Completion.

END OF SECTION 260125

SECTION 260310 – MEDIUM VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes medium voltage switchgear, each consisting of an incoming line section, a metering section, auxiliary section, interlocking between main and tie switch, tie switch, and an outgoing section.

1.3 SUBMITTALS

- A. General: Submit the following:
 - 1. Dimensioned plans and elevations showing major components and features
 - 2. One-line diagram
 - 3. Materials list
 - 4. Nameplate legends
 - 5. Size and number of bus bars and current rating for each bus including mains and branches of phase, neutral and ground buses.
 - 6. Short-time and short-circuit current ratings of switchgear and components.
 - 7. Ratings of individual protective devices.
- B. Manufacturer's certification, signed by the manufacturer, certifying that the company complies with the specified requirements. Upon request, submit evidence of manufacturer's experience.
- C. Operating and maintenance data for switchgear and component devices, for inclusion in Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer of medium voltage electrical distribution equipment to perform the installation specified in this section.
- B. Manufacturer Qualifications: A manufacturer regularly engaged in manufacturing switchgear complying with the requirements of these specifications and experienced with at least five projects of similar size and scope.
- C. Electrical Component Standard: NFPA 70 "National Electrical Code" for components and installation.
- D. IEEE Compliance: IEEE Standard C2, "National Electrical Safety Code."

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as requested by installing contractor.
- B. Coordinate delivery of medium voltage switchgear to a location designed by the construction project manager.
- C. Store protected from weather and so condensation will not form on or in switchgear components. Provide temporary heaters in accordance with manufacturer's recommendations to prevent condensation.
- D. Handle switchgear components in accordance with manufacturer's instructions. Use factory installed lifting provisions.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete bases and pads. Cast anchor bolt inserts into pads necessary to comply with seismic restraint requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ABB, General Electric
 - 2. S&C
 - 3. Square D Company
 - 4. Siemens

2.2 SWITCHGEAR

- A. General: Factory tested, with functions and circuit assignments and types, characteristics, ratings and arrangements of components as indicated. Provide assemblies with factory-coordinated components having ratings and characteristics of connecting elements for switchgear sections that are directly connected or are connected through busways or other conductor systems.

2.3 CONSTRUCTION

- A. Load-Interrupter Switch: Stationary mounted in switchgear and including the following features:

1. Arrangement and Rating: Gang operated, rated 600 amperes for continuous duty and for load break. Suitable for operation up to the maximum short-circuit rating of the integrated switchgear assembly.
 2. Switch Action: No external arc. Interrupting action shall not liberate significant quantities of ionized gas into the enclosure.
 3. Switch Construction: Switch-blade material shall be copper. Switch and all associated parts including electrical and mechanical connections shall be supported entirely from the interior framework of the structure. Switch shall have external manual-operating handle with lock-open padlocking provisions for multiple padlocks.
 4. Operating Mechanism: Quick-make, quick-break, stored-energy type.
 5. Barriers: Phase barriers for the full length of the blades and fuses for each pole. If a protective barrier is used, it shall be designed for easy removal. The barrier material shall allow visual inspection of the switch with the barrier in place.
 6. Protective shield to cover potentially live parts and terminals.
 7. Fuses: De-energized when switch is open.
 8. Mechanical interlock shall prevent opening the door unless the switch blades are open and closing the switch if the door is open.
 9. Window: For viewing switch-blade positions.
 10. Duty Cycle Fault Closing Rating: 25,000 amperes RMS asymmetrical.
- B. Surge Arrestors: Distribution class. Comply with NEMA LA 1" Surge Arrestors." Connect in each phase of incoming circuit.
- C. Power Fuses: Current ratings as indicated. Each fuse shall have an indicator to show it has blown. Fuses shall meet applicable requirements of NEMA Standard SG 2, "High Voltage Fuses," and the following:
1. Fuses shall be positively held in position with provision for easy removal and replacement from the front without the use of special tools.
 2. Spares: Each fusible bay shall include three fuses in use and three spare fuses in storage clips.
 3. Expulsion Fuses: Furnished in disconnect-type mountings and renewable with replacement fuse units. Gases emitted on interruption shall be controlled and silenced by chambers designed for that purpose. Westinghouse Type RBA or equal.
 4. Interrupting rating of fuses at rated system voltage shall be as indicated.
- D. Ratings:
1. 12.47kV Nominal
 2. 15.5 kV Max Design
 3. 600A
 4. 95KV BIL
 5. 40KA RMS sym. momentary current
- E. Accessory Components and Features

1. Accessory Set: Include tools and miscellaneous items as required for test, inspection, maintenance and operation.
2. Spare Fuse Cabinet: Suitable identified, wall-mounted, lockable, compartmented, steel box or cabinet. Arrange for wall mounting.
3. CTs and PTs per utility requirements.

2.4 IDENTIFICATION

- A. General: Refer to Division 26 Section "Electrical Identification." Identify units, devices, controls and wiring with factory-applied labels and signs.
- B. Compartment Nameplates: Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install switchgear in accordance with manufacturers' written instructions and the following specifications.
- B. Care shall be taken not to damage the switchgear during moving and installation.
- C. There shall be an 8 foot long, level, clear area in front of doors and a 3 foot level clear area by switch operating handle locations to allow for safe operating and maintenance.
- D. Route cable beneath switchgear to avoid excessive slack.
- E. The switchgear shall be bolted down to the pad per manufacturer's recommendations.
- F. The edges of the switchgear shall be sealed with clear silicone caulk.
- G. Cable connections shall be torqued to manufacturer's recommendations.
- H. The switchgear shall be grounded to a ground ring detailed in the concrete pad detail on plans. All cable shield drain lines shall be connected to the grounding conductor.
- I. Framed Operating Instructions: Frame printed operating instructions and emergency procedures under clear acrylic plastic and mount on the switchgear front.

3.2 CONCRETE BASES

- A. Provide concrete pad per detail on drawing. Provide (2) ground rods exothermically bonded to concrete pad rebar and grounding ring prior to pouring concrete.

3.3 IDENTIFICATION

- A. Provide nameplates as specified.

3.4 GROUNDING

- A. Grounding of Switchgear Components: As specified in Division 26 Section, "Grounding."
- B. Equipment Grounding Connections: Ground equipment to main electrical ground bus indicated. Provide maximum 5-ohm ground resistance at switchgear location.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to supervise the assembling and connecting of components, pretesting of switchgear and adjusting of switchgear components.
- B. Test continuity of circuits.
- C. Insulation ground well test (Megger) at 5kV DC must be performed after all splices and terminations have been completed. Written report of results of tests with resistance values shall be delivered to the engineer.
- D. If Megger test is passed, a Hipot test shall be performed on the switchgear at 35 kVDC for 15 minutes.
- E. Quality Control Procedure: Assure switchgear installation is operational with industry tolerances, installed in accordance with the specified requirements and suitable for energizing.

3.7 COMMISSIONING

- A. Coordinate with utility company to energize switchgear and for metering requirements.
- B. Remove temporary lifting eyes, channels, brackets and temporary blocking of moving parts from sections and components.

END OF SECTION 260310

SECTION 260430 - SERVICE SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes low-voltage power service and distribution switchboards and associated auxiliary equipment rated 600 V or less.

1.3 QUALITY ASSURANCE

- A. Provide switchboard assemblies that are listed and labeled as defined in the National Electrical Code, Article 100. Service Switchboards shall meet NEC Article 110 Requirements For Electrical Installation and Article 408 Switchboards and Panelboards.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code."
- C. NEMA Standard: Comply with NEMA Standard PB2, "Dead Front Distribution Switchboards."
- D. UL Standard: Comply with UL 891, "Dead Front Switchboards."
- E. NECA 400, "Standard for Installing and Maintaining Switchboards."
- F. Product Selection for Restricted Space: The Drawings indicate dimensions for switchboard equipment including clearances between switchboard and adjacent surfaces and items. Provide switchboards which have equal performance characteristics and which comply with indicated dimensions.
- G. Switchboard shall be UL listed and labeled for use as service entrance equipment.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to assure avoiding condensation.
- C. Handle switchboards in accordance with NEMA Standard PB2.1, "General Instructions for Proper Handling, Installation, Operation and Maintenance of Dead Front Distribution Switchboards." Use factory-installed lifting provisions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. ABB, General Electric
 2. Square D Co.
 3. Siemens Energy & Automation, Inc.

2.2 FABRICATION

- A. The switchboard framework shall be fabricated on a die-formed steel base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all coverplates, bussing, and component devices during shipment and installation. Each switchboard section shall have an open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with wiring installed and laced with flexibility at the hinged side. Wireways, and sides and rear, shall have removable bolt-on or screw-on cover panels. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.
- B. The switchboard bus shall be tin-plated copper of sufficient cross-sectional area to continuously conduct rated full load current with a maximum temperature rise of 65 degrees. Copper bus bars shall be 98% conductive and their current density shall not exceed 1,000 Amperes per square inch.
- C. The bus bars shall have minimum short circuit bracing of 100,000 RMS amps symmetrical. The main horizontal bus bars between sections shall be located to permit a maximum of available conduit area and shall be fitted with a plastic barrier over the top to protect it from falling objects when energized. The end section shall have bus bar provisions for future addition of a switchboard section. The provisions shall include the bus bars installed to the extreme side of the switchboard and prepunched to facilitate future bolted splice plates. Neutral busses shall be the same size and material as the phase busses. Switchboard shall be provided with a copper ground bus, which shall be bonded to the switchboard enclosure.
- D. Main/source bussing shall be fully insulated or have barriers to prevent inadvertent contact.
- E. Neutral bus bar shall be rated (100% of phase bus bars).
- F. All power and ground lugs shall be compression type, long barrel double hole, copper type lugs.
- G. Assemblies shall be provided with local instrumentation and control system for automatic and manual operation of the system and for monitoring and control during operation.

- H. Assemblies shall be equipment with appropriate devices for local testing, monitoring, and lock-out tag-out.
- I. Each assembly shall include digital metering for local display of voltage, power quality, and event logging.
- J. All settable relays or other devices mounted inside the assemblies shall be installed in compartments with a hinged cover.
- K. Infrared inspection windows shall be provided to allow energized inspection of all connections

2.3 ENCLOSURE

- A. Type 1 building interior locations with front only access.
- B. Sections shall be aligned front and rear. Front covers shall be hinged and latched with provisions for pad locking.
- C. Removable steel base channels (1.5 inch floor sills) shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
- D. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
- E. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
- F. Top and bottom conduit areas shall be clearly indicated on shop drawings.
- G. Main-Tie-Main assemblies shall be three separate vertical sections with busduct or cable connections between each section to allow for each section to be serviced and isolated from adjacent sections arc flash energy.

2.4 OVERCURRENT DEVICES

- A. Main-Tie-Main assemblies shall have interlocks to prevent a condition of all three breakers closed at the same time.
- B. Switches 800 ampere and larger shall be the fusible bolted pressure contact type with ratings as shown on the drawings. The switches shall have switch blades which are visible in the OFF position when the door is open. Bolted pressure contacts shall be made by firmly bolting the switch blades to the stationary contact terminals and to the hinge terminals. Switches having butt-type contacts will not be accepted. Lugs shall be suitable for copper conductors and shall be front removable. All current-carrying parts shall be plated. The switch mechanism shall be front-operated, fusible, 3 pole (w/full neutral assembly), and shall have a quick-make, quick-break operating mechanism. The switch handle shall have provisions for locking in the OPEN or CLOSED positions with at least three padlocks. A mechanical interlock shall be provided to prevent opening the door when the switch is closed. The switches shall be fusible for NEMA 1

Class L current-limited fuses. The switches shall be manufactured and tested in accordance with NEMA and UL standards where applicable. The switches shall be of equal quality to those manufactured by Pringle.

- C. Switches 600 amperes and less shall be quick-make, quick-break and suitable for use on the service as described for the sizes as shown on the associated drawings. The units, where applicable, shall be horsepower rated for dual-element fuses. The fusible switches shall be group mounted in panel-type construction. Each switch is to be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses which shall be interlocked with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service. The units shall have padlocking provisions in the OFF position and the operating handle position shall give positive position indication, e.g., horizontal OFF, diagonal ON.
- D. Fused switches shall be NEMA KS 1, type HD; clips to accommodate specified fuses.
- E. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - 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).
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.5 GROUND FAULT PROTECTION

- A. Provide a ground fault protection system to control the main switch as indicated on the drawings. Each set of ground fault protection equipment shall consist of a ground monitor, encircling all phase and neutral conductors, connected to a solid-state ground relay sensor which initiates tripping of the circuit interrupting device. Ground protection shall provide an adjustable time delay relay range from instantaneous to 60 cycles and an adjustable trip setting. Circuit interrupter shunt trip and relay shall operate from a 120 volt AC control source. Control transformers within the switchboard shall be used for 120 volt AC source for higher incoming voltages. Where main and feeder ground fault protection is shown, the sensor units shall have interlocking circuitry to cause the feeder circuit to operate instantaneously for a fault on its load side and to restrain the ground fault sensor upstream from operating until the preselected time setting is reached. Set these relays as recommended by the manufacturer and NEC. Furnish, mounted on the switchboard, a test panel to test each ground fault sensor in the switchboard. The system shall be arranged so that sensors can be tested without tripping the device and also by tripping the device.
- B. Shunt trips for use with ground fault protection devices shall be furnished with switches as indicated on the drawings. Switches shall be furnished with fuses of the size and type indicated on the drawings. Switches shall be equipped with de-ionizing arc quenchers and an external operating handle which may be locked in either "ON" or "OFF" position. Handle shall be clearly marked to indicate position of switch. The switch cover shall have a cover interlock with provisions for momentarily voiding the interlock.

2.6 INSTRUMENTATION

- A. Multifunction Digital Metering: UL listed or recognized microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Inputs: From sensors or current transformers from 100/5 through 5000/5 ratings and potential transformers up to 600 V.
 - 2. Display: Switch selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase currents, each phase.
 - b. Phase-to-phase voltages, 3 phase.
 - c. Phase-to-neutral voltages, 3 phase.
 - d. Watts.
 - e. VA.
 - f. Vars.
 - g. Power factor.
 - h. Frequency.
 - i. Megawatt demand with demand interval programmable from 5 to 60 minutes.

- j. Accumulated energy, megawatt hours.
 - k. Accumulated values unaffected by power outages up to 72 hours.
 - l. Alarm functions, including voltage and current loss, etc.
- 3. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
- B. Multifunction Digital Meter shall be Square D, Power Logic, or one of the following products of equal characteristics:
 - 1. Cutler Hammer IQ
 - 2. General Electric Power Leader
 - 3. Siemens Power Meter

2.7 QMBIMA SURGELOGIC SPD UNIT

- A. The internally mounted SPD shall be mounted in the Service Switchboard.
- B. SPD shall be listed in accordance with UL 1449 Second Edition to include Section 37.3 highest Short Circuit Current Rating (SCCR) of 200 KA.
- C. SPD shall be tested with the ANSI/IEEE Category C3 high exposure waveform (20kV-L2/50us. 10kA-8/20us.).
- D. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
- E. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance. Distribution equipment shall be fully tested and certified to the following UL standards:
 - 1. UL 67 = Panelboards,
 - 2. UL 845 = Motor Control Centers,
 - 3. UL 857 = Busway,
 - 4. UL 891 = Switchboards,
 - 5. UL 1558 = Low Voltage Switchgear.
- F. Each SPD mode, including N-G, shall be fused with a 200 kAIR, UL recognized surge rated fuse and incorporate a thermal cutout device. SPD shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200kA, including low level fault currents from 5 to 5000 amperes.
- G. SPD ratings:
 - 1. Minimum surge current rating shall be 320 kA per phase (160 kA per mode) for service entrance.

2. UL 1449 clamping voltage must not exceed the following:

VOLTAGE	L-N	L-G	N-G
480Y/277	800V	800V	800V

3. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C3 transients without failure or degradation of clamping voltage by more than 10%.

- H. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- I. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
- J. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
- K. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.
- L. Terminals shall be provided for necessary power and ground connections.
- M. The SPD shall be equipped with the following optional items:
1. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.
 2. A remote monitoring device shall be provided to directly connect to the SPD with a dry contact connector for simple installation. The device will have indicator lights and an audible alarm to monitor for normal and fault conditions.
- N. SPD shall have a warranty for a period of five (5) years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.8 RATINGS

- A. System voltage, continuous main bus amperage and short-circuit-current ratings shall be as indicated on the drawings.

2.9 NAMEPLATE

- A. Provide black plastic nameplate with 3/16" white letters showing switchboard designation, voltage phase and supply circuit origin, and ampere ratings, short circuit ratings and manufacturer's name and sales order number. Label each overcurrent protective device to show the load it supplies.
- B. Include permanent one-line diagram mimic bus.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install switchboards and accessory items in accordance with manufacturers' written installation instructions.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels and brackets and temporary blocking of moving parts from switchboard units and components.
- C. Provide the necessary support system to satisfy the requirements of the seismic region indicated on the drawings.

3.2 CONCRETE PAD

- A. Install floor mounted switchboard on a 4" nominal height concrete housekeeping pad 1" larger in both dimensions than the equipment to be set. Provide steel reinforcing per ACI recommendations. Pad to be rated for seismic conditions, level and anchor the switchboard to the pad.

3.3 GROUNDING

- A. Connections: As indicated. Tighten connections to comply with tightening torques specified in UL 486A and 486B.
- B. Ground equipment to main electrical ground bus indicated. Provide minimum 5-ohm ground resistance at switchboard location.

3.4 CONNECTIONS

- A. Tighten switchboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Upon completing installation of the system, perform the following tests:
 - 1. Insulation resistance tests of switchboard buses, components and connection supply, feeder and control circuits.
 - 2. Continuity tests of circuits.

- B. Visual and Mechanical Inspections: Include the following inspections and related work:
 - 1. Inspect for defects and physical damage, testing laboratory, labels and nameplate compliance with up-to-date circuit connections.
 - 2. Verify that potential transformers, including their overcurrent protection and current transformers meet specified requirements.
 - 3. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - 4. Check switchboard anchorage, area clearances and alignment and fit of components.
 - 5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

3.6 CLEANING

- A. Upon completion of installation, clean interior and exterior of switchboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each section of switchboards throughout periods during which the switchboard is not in a space that is continuously under normal control of temperature and humidity.

- 3.8 Provide arc flash warning labels for switchboards as indicated on plans.

END OF SECTION 260430

SECTION 260440 – GENERATOR DOCKING STATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes generator docking station, interlocking provision, and connections for permanent generator, temporary generator, and load bank.

1.3 SUBMITTALS

- A. General: Submit the following:
 - 1. Dimensioned plans and elevations showing major components and features
 - 2. One-line diagram
 - 3. Materials list
 - 4. Nameplate legends
 - 5. Size and number of bus bars and current rating for each bus including mains and branches of phase, neutral and ground buses.
 - 6. Ratings of individual protective devices.
- B. Manufacturer's certification, signed by the manufacturer, certifying that the company complies with the specified requirements. Upon request, submit evidence of manufacturer's experience.
- C. Operating and maintenance data for generator docking station and component devices, for inclusion in Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer of electrical distribution equipment to perform the installation specified in this section.
- B. Manufacturer Qualifications: A manufacturer regularly engaged in manufacturing generator docking station complying with the requirements of these specifications and experienced with at least five projects of similar size and scope.
- C. Electrical Component Standard: NFPA 70 "National Electrical Code" for components and installation.
- D. IEEE Compliance: IEEE Standard C2, "National Electrical Safety Code."

1.5 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of generator docking station to a location designed by the construction project manager.
- B. Store protected from weather and so condensation will not form on or in generator docking station components. Provide temporary heaters in accordance with manufacturer's recommendations to prevent condensation.
- C. Handle generator docking station components in accordance with manufacturer's instructions. Use factory installed lifting provisions.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete bases and pads. Cast anchor bolt inserts into pads necessary to comply with seismic restraint requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Trystar
 - 2. ASCO
 - 3. Powertron

2.2 GENERATOR DOCKING STATION

A. Enclosure

1. NEMA 3R Rain-Tight Enclosure

- i. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
- ii. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use
- iii. Front and Side shall be accessible for maintenance
- iv. Top, Side, and Bottom shall be accessible for permanent cabling

2. Paint/Powder coat

- i. Gray

B. Phase, Neutral, and Ground Busbar

- 1. Material: Silver-plated Copper

2. Equipment Ground Bus: bonded to box.
 3. Isolated Ground Bus: insulated from box.
 4. Ground Bus
 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
- C. Temporary generator and Load Bank connectors shall be Camlok style mounted on gland plate.
1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
 2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
 3. Camlok connection shall be protected against accidental contact while not in use
- D. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier
- E. Short Circuit & Withstand Rating
1. Shall be minimum 30 KAIC
- F. Voltage & Amperage
1. 480V, 3 phase, 4 wire, 1200A with hardwire provisions for 750kW permanent load bank and 750kW permanent generator.
- G. Factory Installed Phase Rotation Monitor Device:
1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed
- H. Breaker Disconnects in Permanent Line, Temporary Line, and Hardwired Load Bank Positions
1. Must be UL 489 Listed Breaker
 2. Interlocked permanent line breaker and temporary line breaker
- I. Additional accessories shall be included in submittal drawing as follows:
- A: Two Wire Auto Start
- B: Battery Charger Receptacle 20A DUPLEX 125V
- K#: Kirk Key Door Interlock
- M: Listed Monitoring Device
- Q: Load Dump Receptacle

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install generator docking station in accordance with manufacturers' written instructions and the following specifications.
- B. Care shall be taken not to damage the generator docking station during moving and installation.
- C. The generator docking station shall be bolted down to the pad per manufacturer's recommendations.
- D. Cable connections shall be torqued to manufacturer's recommendations.
- E. Framed Operating Instructions: Frame printed operating instructions and emergency procedures to be permanently mounted to docking station.

3.2 IDENTIFICATION

- A. Provide nameplates as specified.

3.3 GROUNDING

- A. Grounding of Generator docking station Components: As specified in Division 26 Section, "Grounding."
- B. Equipment Grounding Connections: Ground equipment to main electrical ground bus indicated. Provide maximum 5-ohm ground resistance at generator docking station location.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to supervise the assembling and connecting of components, pretesting of generator docking station and adjusting of generator docking station components.
- B. Test continuity of circuits.
- C. Quality Control Procedure: Assure generator docking station installation is operational with industry tolerances, installed in accordance with the specified requirements and suitable for energizing.

3.6 COMMISSIONING

- A. Coordinate with utility company to energize generator docking station and for metering requirements.
- B. Remove temporary lifting eyes, channels, brackets and temporary blocking of moving parts from sections and components.

END OF SECTION 260440

SECTION 262470 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section covers circuit breaker lighting and appliance panelboards, and power circuit breaker panelboards.

1.3 QUALITY ASSURANCE

- A. Panelboards shall comply with the requirements of the National Electrical Code, NEMA, ANSI, IEEE and OSHA. Panelboards shall bear the Underwriter's Laboratories Label.
- B. Comply with NEMA Standard PB1, "Panelboards".
- C. Comply with UL Standards 67, "Panelboards" and UL50, "Cabinets and Boxes".
- D. Comply with NECA 407, "Recommended Practice for Installing and Maintaining Panelboards."

1.4 SUBMITTALS

- A. Product Data: For each panelboard and overcurrent protective device, including dimensions, ratings, finishes and components.
- B. Panelboard Schedule: Typewritten for installation in panels.
- C. Time-current curves for each overcurrent protective device.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide panelboard products of one of the following:
 - 1. Square D
 - 2. Cutler Hammer
 - 3. General Electric

2.2 CIRCUIT BREAKER LIGHTING AND APPLIANCE PANELBOARDS

- A. Panelboards shall be dead front safety type with a door-in-door hinge equipped with circuit breakers. Each panelboard shall have an integrated short circuit withstand rating equal to the short circuit interrupting capacity of the circuit breakers. Panelboard bus structure and main lugs or main circuit breaker shall have current and voltage ratings, and number of phases, poles, and wires as indicated on the drawings.

- B. Circuit breakers shall be quick-make, quick-break, bolt-on type having over-center toggle mechanisms with thermal-magnetic trips and shall be trip free. Bolt-in breakers shall be used. Plug-in circuit breakers are not acceptable. Multi-pole circuit breakers shall have common trips and a single operating handle. Handle tie bars will not be accepted. Circuit breakers shall be provided with a means for indicating a tripped position, and shall be capable of being locked in the open position. Branch circuit breakers shall be replaceable without disturbing adjacent units. Circuit breaker voltage, ampere rating, and number of poles shall be as indicated on the drawings. Circuit breakers shall have a minimum short-circuit interrupting capacity of 10,000 amperes RMS for 120/208V panels and 14,000 amperes RMS for 277/480V panels. Circuit breakers shall be equipped with individually insulated, braced, and protected connectors. General purpose power circuits shall be a minimum of 20 amps.
- C. UL class A (5 milliampere sensitivity) and Class B (30 milliampere sensitivity) ground fault circuit protection shall be provided on 120 VAC branch circuits as shown on the plans or in the panelboard details. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional single pole circuit breaker.
- D. The panel box shall be fabricated from code gauge galvanized steel. Unless otherwise indicated, panelboards shall be standard width with boxes having a minimum width of 20 inches and a maximum depth of 5-3/4 inches. Enclosure shall prevent the entry of a #12 gauge wire.
- E. The panelboard front shall be surface or flush mounted as indicated on the drawings, fabricated from cold-rolled steel, coated with rust-inhibiting primer, finished with ANSI-61 light gray baked-on enamel paint, and shall have a door equipped with concealed hinges, a semi-flush or flush lock requiring a milled key, a framed directory card with a clear plastic covering mounted on the inside of the door. At least two keys shall be provided with each panelboard and all panelboard locks shall be keyed alike. The panelboard front shall be fastened to the panel box with machine screws or other approved fastening hardware and shall not be removable with the door in the closed position.
- F. Interiors shall be equipped with bussing, circuit breakers, and adjustable means for positioning the interior within the enclosure.
- G. Main bus and circuit breaker branch bus shall be copper having 98% conductivity. Aluminum bus shall not be acceptable. Full size neutral busses shall be insulated from the panelboard. The location of the main terminations shall be determined by the entrance of the feeders to the panelboard enclosure. In those cases where the feeders pass through the panelboard assembly, extra wide gutters shall be provided.
- H. Double width panels: Where more than 42 poles are indicated or where otherwise indicated, provide an 84 circuit panel, or provide two panelboards under single front, each section with separate door and each section with similar space configuration.

- I. The panelboard interior shall be provided with a ground bus, which shall be bonded to the panelboard enclosure. Provide separate isolated ground bus where indicated.
- J. The isolated neutral bus and the equipment ground bus shall be provided with an individual terminal or lug for each wire connected to it.
- K. Terminals for feeder conductors to the panelboard mains and neutral shall be two-bolt compression lugs UL listed as suitable for the type of conductor specified. Terminal for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.
- L. Bussing sequence shall be distributed phase sequence type. Bus sequence shall start at the top left phase bus of the interior for both top and bottom feed panels. Provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker. Locate next to each breaker, space, or provision an individual number permanently affixed to the panelboard. Numbering tape or painted numbers shall not be acceptable.
- M. The inside of the panel or door shall have a printed nameplate indicating the name of the panel manufacturer, shop order number, panel type, system voltage and bus ampacity. Panel shall be marked with its UL short circuit withstand ratings.
- N. Circuit breaker lighting panelboards shall be Square D type NQ or NQOD, 120/208 volts, and Square D type NF, 277/480 volts or equal by General Electric or Cutler-Hammer.
- O. The circuit breakers supplied shall be tested and listed as fully rated. Circuit breakers shall have bolted bus connections. The short circuit current rating shall be marked on the panelboards and shall be equal to or greater than the short circuit current available, in compliance with NEC Sections 110-22 and 240-86.
- P. Load centers are not permitted.
- Q. Provide external Surge Protective Devices (SPD) per Specification Section 262475. Provide circuit breaker disconnect per manufacturers requirements.

2.3 POWER CIRCUIT BREAKER PANELBOARDS

- A. Power circuit breaker panelboards shall be dead-front safety type. The panel, including all bus bracing, circuit breakers, and associated current carrying components, shall have a minimum integrated short circuit withstand rating of 50,000 amperes RMS symmetrical. The panel bus structure and main lugs or main switch shall have current and voltage ratings, and number of phases, poles, and wires as indicated on the drawings.
- B. Bus bars shall be copper. Neutral busses shall be insulated from the panel. Main horizontal bussing shall be full size throughout without reduction. The bus structure shall accommodate bolted branch switches as indicated on the drawings without modification to the bus assembly. No additional lineside wiring shall be necessary to add breakers. Space for future circuit breakers shall be bussed for the maximum devices that can be fitted into them.
- C. Where panelboards are equipped with ground fault protection, all overcurrent protective devices installed shall have ground fault protection. Ground fault sensing shall use individual

phase sensing and a neutral current sensor (such as a current transformer). Single unit (zero sequence) sensors shall NOT be used.

- D. Circuit breaker power panelboard shall be Square D type I-Line or equivalent from Cutler-Hammer or GE.
- E. Circuit breaker frame sizes rated 200 amps and larger shall have interchangeable trips.
- F. Provide external Surge Protective Devices (SPD) per Specification Section 262475. Provide circuit breaker disconnect per manufacturers requirements.

2.4 EXISTING PANELBOARDS

- A. Where drawings indicate existing panelboards are to be reused to serve electrical loads, comply with the following requirements.
- B. Existing circuit breaker panelboards.
 - 1. Replace any defective circuit breakers with new circuit breakers of the same trip rating, interrupting capacity and number of poles.
 - 2. Provide new circuit breakers when existing circuit breakers installed in the panelboard are not of the correct trip rating, interrupting capacity and number of poles to serve the new loads.
 - 3. Provide blank covers over any existing unused openings.
- C. Existing fusible panelboards
 - 1. Provide new fuses of the rating and size required to serve new loads.
- D. At any existing panelboard where work is performed, provide a ground bus if none exists.
- E. Provide new circuit directories. Provide new panel nameplate if there is no existing nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Install filler plates in unused spaces.
- C. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."
- D. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish. Top of trim shall be 74" AFF, unless noted otherwise. Mount adjacent boxes with tops aligned.

- E. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.
- F. Install panelboards with proper code required clearances at front of and above equipment. Coordinate with other trades prior to rough-in. Verify proper wall thickness for recessed panels.

3.2 CONCRETE PAD

- A. Install floor mounted panels on a 4" nominal height concrete housekeeping pad 1" larger in both dimensions than the equipment to be set. Provide steel reinforcing per ACI recommendations. Pad to be rated for seismic conditions, level and anchor the unit to the pad.

3.3 CONNECTIONS

- A. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.
- B. Wiring in Panel Gutters: Train conductors neatly in groups, bundle and wrap with wire ties after completion of load balancing. All wire connections, with the exception of screw terminals, shall be wire nut type suitable for copper wire.

3.4 IDENTIFICATION

- A. Each panelboard shall have a black plastic nameplate with 1/4" white letters, indicating the panel name, voltage, phase and feeder origin. Label each circuit breaker sequentially from left to right and top to bottom with permanent tags.
- B. Circuit Directory: Provide typewritten directory describing the load and location of each circuit and reflective of final circuit changes required to balance panel loads. Balance the loads supplied by the panel board in accordance with NECA 407.

END OF SECTION 262470

SECTION 260475 – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes surge protective devices for low-voltage power (< 1000 volts) equipment.
- B. Related sections include the following:
 - 1. Section 260140 - Wiring Devices, for devices with integral surge protection.
 - 2. Section 260430 - Switchboards, for locations that require installation at the Service Entrance Switchboard.
 - 3. Section 260470 - Panelboards, for locations that require installation at the panel or sub-panel level.
- C. The installation shall be in conformance with NEC Article 285.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, shipping, installed and operating weights, furnished specialties, and options. Include model number, type, system voltage, phases, modes of protection, voltage protection rating (VPR) and nominal discharge current (In).
- B. Product Certifications: Signed by manufacturers of surge protective devices, certifying that products furnished comply with the following testing and labeling requirements:
 - 1. UL 1449 5th Edition and UL 1283 listing and classifications. SPD shall bear the UL mark and shall be listed to UL 1449 5th Edition and most recent edition of UL 1283. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification.
- C. Maintenance Data: For surge protective devices to include in maintenance manuals specified in Division 1.
- D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product must be made by a company engaged in the manufacture of such devices for a minimum of five years.
- B. Source Limitations: Obtain protective devices and accessories through one source from a single manufacturer.

- C. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Other manufacturers' products complying with requirements may be considered by the engineer/architect greater than 14 days prior to bid. Samples may be required for approval. Devices mounted integral to the switchboard or panelboard do not meet the intent of this specification.
- 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. IEEE Compliance: Comply with ANSI/IEEE C62.41-2002, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits" and test devices in accordance with ANSI/IEEE C62.45-2002, "IEEE Guide for Surge Suppressor Testing".
- F. UL Compliance: Comply with UL 1449 Rev. 3 "UL Standard for Safety for Surge Protective Devices" and UL1283 "Electromagnetic Filters".

1.5 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment or panelboards to their sources until the surge protective devices are installed and connected. Do not single phase, hi-pot or megger service entrance equipment without disconnecting the surge protective device, as damage to the surge protective device may result from these procedures.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum continuous operating voltage: Not less than 110% of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg. F
 - 3. Humidity: 0 to 95%, non-condensing.
 - 4. Altitude: Less than 12,000 feet above sea level.

1.6 COORDINATION

- A. Coordinate location of field mounted surge suppressors to allow adequate clearances for maintenance.
- B. Coordinate surge protective devices with Division 26 Sections "Electrical Power Monitoring and Control" and "Lightning Protection".

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Specialty Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within eight years (96 months) from date of Substantial Completion or 10 years (120 months) from date of manufacture. Warranty shall include parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements of this specification listed herein, provide products by one of the following manufacturers:
 - 1. Current Technology
 - 2. Emerson Network Power / Edco
 - 3. Advanced Protection Technologies
 - 4. Eaton Corporation
 - 5. Schneider Electric
 - 6. Siemens
 - 7. Surge Suppression Incorporated
- B. This specification is performance based, and any other vendors who desire approval to bid this project shall provide written documentation of any deviations from this specification, which shall be included in product submittal 14 days prior to bid.

2.2 SERVICE ENTRANCE SUPPRESSORS (TYPE 1)

- A. Surge protective device: The system shall be constructed using a primary and secondary stage hybrid transient suppression system. The primary stage shall be constructed utilizing silicon avalanche diodes (SAD) technology or selenium integrated suppression modules (ISM). The secondary stage shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to a variance of +/- 1 volt. Subject to compliance with requirements.
- B. Product certifications: Products furnished comply with the following testing and labeling requirements: UL 1449 and UL 1283 listing and classifications including fault current rating to meet or exceed service entrance equipment.
- C. Maximum continuous operating voltage: 115% (or 125% at 120VAC) of nominal system operating voltage at 60 hz.
- D. Peak single impulse surge current capacity, in all modes. Data obtained from actual tests (per mode):
 - 1. Line to Neutral: 200,000 Amperes
 - 2. Line to Ground: 200,000 Amperes
 - 3. Neutral to Ground: 200,000 Amperes

4. Line to Line: 200,000 Amperes
- E. Listed to UL 1449 5th Edition, Voltage Protection Ratings (VPR) shall not exceed:
 1. 277/480 volt wye - L-N 1200, L-G 1200, N-G 1200, L-L 1800
 2. 120/208 volt wye - L-N 800, L-G 800, N-G 800, L-L 1200
 - F. Nominal Discharge Current Rating (In): 20 kA.
 - G. Integral EMI/RFI filter for high frequency noise (10 kHz to 100 mHz) attenuation.
 - H. Features to include:
 1. LED indicator lights for power and protective status for each mode.
 2. Fault current UL tested and labeled for 200 kAIC.
 3. NEMA type 4, 4X, or 12 enclosure.
 4. Monitoring with audible alarm, including test and silence switch and form "C" alarm relay.
 5. SPD will have a warranty period as stated above with five (5) years of free replacement.
- 2.3 PANELBOARD SUPPRESSORS (TYPE 1 OR 2)
- A. Provide Type 1 suppressors at service entrance locations.
 - B. Surge protective device: The system shall be constructed using a primary and secondary stage hybrid transient suppression system. The primary stage shall be constructed utilizing silicon avalanche diodes (SAD) technology or selenium integrated suppression modules (ISM). The secondary stage shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) computer matched to a variance of +/- 1 volt.
 - C. Product certifications: Products furnished comply with the following testing and labeling requirements: UL 1449 5th Edition and UL 1283 listing and classifications including fault current rating to meet or exceed panelboard.
 - D. Maximum continuous operating voltage: Between 115% (or 125% at 120VAC) of nominal system operating voltage at 60 HZ.
 - E. Peak single impulse surge current capacity all modes. Data obtained from actual tests (per mode):
 1. Line to Neutral: 100,000 Amperes
 2. Line to Ground: 100,000 Amperes
 3. Neutral to Ground: 100,000 Amperes
 4. Line to Line: 100,000 Amperes
 - F. Listed to UL 1449 5th Edition, Voltage Protection Ratings (VPR) as follows:
 1. 277/480 volt wye - L-N 1,200, L-G 1,200, N-G 1,200, L-L 1800
 2. 120/208 volt wye - L-N 800, L-G 800, N-G 800, L-L 1200
 - G. Nominal Discharge Current Rating (In): 20 kA.

- H. Integral EMI/RFI filter for high frequency noise (10 kHz to 100 mHz) attenuation.
- I. Features to include:
 - 1. LED indicator lights for power and protective status for each mode.
 - 2. Fault current UL tested and labeled for 100 kAIC.
 - 3. NEMA type 3R, 4, 4X, or 12 enclosure.
 - 4. SPD will have a warranty period as stated above with five (5) years of free replacement.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Provide multi-pole, 60- amp (or as recommended by manufacturer) overcurrent protective device as a dedicated disconnect for the SPD at service entrance location, unless otherwise indicated on drawings.
- C. Install devices for service entrance and panelboards, as indicated per electrical drawings, with conductors between suppressor and points of attachment as short and as straight as possible. Do not exceed manufacturer's recommended lead length.
- D. Provide multi-pole, 30 amp (or as recommended by manufacturer) overcurrent protective device as a dedicated disconnect for the SPD at panelboard locations, unless otherwise indicated on drawings.
- E. Mount suppressor as close as possible to switchgear and panelboard point of connection. Do not mount internal to switchgear or panelboards to facilitate ease of future maintenance and/or replacement. Installer may reasonably rearrange OCPD location from that shown on drawing to ensure the shortest and straightest possible leads to SPD's.

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality control testing:
 - 1. After installing the surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements. Verify service and separately derived system neutral-to-ground bonding jumpers per NEC.
 - 2. Complete start-up checks and voltage verifications according to manufacturer's written instructions.
 - 3. Perform visual and mechanical inspection on each unit. Certify that units are installed per manufacturer's recommendations.

- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

3.4 DEMONSTRATION

- A. Engage a manufacturer's representative to demonstrate proper operation of the system and to train owner's maintenance personnel in proper evaluation of suppressor condition and procedure to repair or replace defective devices.
 - 1. Review operation and maintenance manuals.
 - 2. Review performance specifications of devices supplied to show they comply with specifications herein.
 - 3. Schedule training with Owner with at least seven days advance notice.
 - 4. Contractor shall provide letter to owner that states units are installed per manufacturer's recommended installation procedures and system is functioning properly and warranty is initiated.

END OF SECTION 260475

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Applicable provisions of Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between this section and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The word "Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- D. The submittal of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.

1.2 RULES AND REGULATIONS - See Division 1.

1.3 PERMITS, LICENSES AND INSPECTION FEES - See Division 1.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying drawings plans (architectural, site, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on all. The intention of the drawings and specifications is to provide complete functioning systems in every respect. Furnish all material and equipment and perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install."
- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed. Obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all required materials. Conduit, wiring, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the drawings are schematic or diagrammatic. These details are not intended to show all materials, etc., required to achieve the arrangement shown. Adapt these details to the actual conditions of the job.
- E. Routing of conduit and location of equipment and other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall

provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.

- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.
- H. Coordinate arrangement, mounting and support of electrical equipment.
 - 1. To allow maximum possible headroom unless specific mounting heights are indicated.
 - 2. To provide for ease of disconnecting equipment with minimum interference to other installations.
 - 3. To allow right-of-way for piping and conduit installed at slopes.
 - 4. So connecting raceway will be clear of obstructions and of the working and access space of other equipment.
- I. All mechanical, electrical, plumbing, fire protection, and HVAC work shall be coordinated by that contractor and any correction to any of the above work shall be at that contractor's expense.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, any discrepancies or omissions in any of the documents or any doubt as to their meaning, should be reported to the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.
- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 VISITING THE SITE – See Division 1.

1.7 SHOP DRAWINGS – See Division 1.

1.8 RELEASE OF CADD FILES

- A. See "Release of Cadd Files Form" at the end of this section.

1.9 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. See Division 1.
- B. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.10 TEMPORARY POWER – EXISTING FACILITIES

- A. The Owner's existing electrical distribution system shall be used for temporary power required for temporary lighting, 120 volt GFI receptacles and power to all construction equipment in accordance with NEC Article 527. Coordinate details of existing service and metering for job site and construction offices with local utility company. Energy charges shall be paid by the General Contractor. If portions of the existing building remain in use by the Owner, then the Owner shall pay the energy charges.
- B. Temporary lighting shall consist of protected incandescent, LED, HID or fluorescent fixtures symmetrically spaced to produce a minimum of 5 footcandles throughout the work areas.
- C. Stairs and other enclosed areas shall have adequate lighting.
- D. The service shall be available during all working hours and scheduled overtime hours and otherwise as necessary for security and safety purposes, with security lighting to be provided during all hours of darkness. All such facilities shall conform to all requirements of the National Electrical Code, the local utility, and all other governmental authorities having jurisdiction.
- E. Temporary power shall be provided for all construction trailers.
- F. Comply with NECA 200-2010, "Recommended Practice for Installing and Maintaining Temporary Electric Power at Construction Sites."

1.11 AS-BUILT RECORD DRAWINGS

- A. During construction, maintain a separate set of drawings at the jobsite to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of conduit and other concealed facilities shall be shown if and when they differ from the drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.12 GUARANTEE AND WARRANTY – See Division 1.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION – See Division 1.

PART 3 - EXECUTION

3.1 RESPONSIBILITY

- A. Provide material, equipment, labor, services, supplies, etc., required to execute to completion work shown on the drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. Schedule work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. Schedule the work to coordinate with the construction.

3.2 COORDINATION OF TRADES

- A. Prior to the installation of any materials, review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. Work installed without coordinating with the other trades, which causes interferences, shall be removed and reworked, at no cost to the Owner.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the Contractor furnishing the controlled equipment.
- F. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls and other structural components as they are constructed.
- G. Coordinate sleeve selection and application with firestopping specified in Division 7.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. Protect and preserve materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc. Provide enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of their negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING – See Division 1.

3.5 DEMOLITION OF FACILITIES

A. GENERAL

- 1. The demolition work shall consist of removal of electrical equipment and materials pertaining to the existing electrical systems as indicated on the drawings.
- 2. Demolition drawings provided are representative of existing conditions, prepared from previous design drawings and field surveys, but may not be all inclusive of existing conditions at the present time. Field verify actual existing conditions and remove all items, whether indicated on drawings or not, as required for new work.
- 3. Include in the bid all demolition work as required and as shown on the drawings.
- 4. Where items are removed, utilities and the area from which the items have been removed shall be left in such a manner that they are safe to both people and property.
- 5. Before disconnection of any systems, advance approved arrangements shall be made to prevent interference with utility services to rooms and structures not otherwise affected by work under this contract.
- 6. Equipment to be reused shall be disconnected, marked and protected where necessary.

B. EXISTING CONDITIONS

- 1. Exercise great caution when performing demolition work so as not to damage existing systems or items of work that are to remain. If the Contractor damages, destroys or removes an existing system which is to remain, the Contractor shall be responsible to repair or replace that system to its original condition.
- 2. Unless specifically stated otherwise on the drawings, where access to electrical items is required, provide the required access by removing ceiling, walls and other obstructions, cutting openings, etc., as required. Prior to cutting openings, outline the openings and obtain approval from the General Contractor and cut openings in the manner directed by the Owner's Representative. Demolition work shall also include the removal and replacement of walls as required for installation or removal of equipment.
- 3. Provide repair and replacement of openings. Materials which are removed and are damaged or soiled shall be replaced with new materials. Ceilings, walls, conduits, etc., shall be properly repaired and restored to as close to the original condition as possible.

Replacement of surface finish materials such as paint, ceiling tile, flooring materials, etc., shall be provided by the General Contractor.

4. Provide repair of floor openings and trenches. Floors shall be repaired to match the level and surface finish of the existing concrete.
5. Areas shall be repaired with materials matching those which have been removed.
6. Where surface mounted devices or raceways have been removed, it is the responsibility of the contractor to repair the wall of any anchors and paint to match surrounding surface.

C. PROTECTION

1. During demolition operations, all persons and property shall be protected. Provide erection of any barriers, fences, guard rails, enclosures, chutes, and shoring to protect all persons and property.
2. The work shall proceed in a manner to minimize any spread of dust, debris and flying particles, and so that any related effects of demolition do not interfere with the surrounding equipment, personnel, or buildings.
3. Where necessary, provide temporary enclosures to be sure that the area is secured, safe and weatherproofed.

D. DISPOSITION OF MATERIAL:

1. Those items of material and equipment to be removed and designated to become the property of the Owner, shall be delivered to an on-site location designated by the Owner. All other materials and equipment removed shall become the property of this Contractor and shall be removed from the job site and legally disposed of.

3.6 EQUIPMENT FURNISHED BY OTHERS

- A. Some pieces of equipment, as indicated on the drawings, will be furnished by the Owner and/or under other Divisions of these specifications. Provide electrical work as shown for connections to this equipment.
- B. Start-up of equipment furnished by the Owner or under other Divisions of these specifications shall be the responsibility of this Contractor under the Section assigned the responsibility to receive and set in place or to move and set in place.
- C. Warranties for equipment furnished shall be by the equipment manufacturer.

3.7 MAINTENANCE OF WORK AREAS

- A. This Contractor shall maintain the work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.

- B. Open ends of conduit, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.8 CLEANING AND CLEANUP

- A. See Drawings and Division 1.
- B. Upon completion of this work, clean all panels, fixtures, and equipment. Leave all work in a finished, clean, and satisfactory working condition.

END OF SECTION 26 0500

RELEASE OF CADD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2018. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CADD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CADD files.

Project Name/ Specific Drawings Requested:

Acknowledged and Agreed:

Company

Version of AutoCAD used

Name (Must be an officer of the Company)

E-mail address

Title

Maximum e-mail attachment size

Date

SECTION 260510 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260500 - Common Work Results for Electrical.

1.2 SCOPE OF WORK

- A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems.

1.3 QUALITY ASSURANCE

- A. Electrical work including, but not limited to, installation, materials, equipment and wiring methods, shall comply with the applicable National Electrical Code, NFPA 70.
- B. Equipment and materials shall comply with the applicable requirements of the following:
 - 1. National Electrical Manufacturer Association (NEMA).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. American National Standards Institute (ANSI).
 - 4. National Electrical Safety Code (ANSI Standard C2).
 - 5. Underwriters Laboratories (UL).
 - 6. National Electrical Contractors Association (NECA).
- C. Comply with NECA 1-2010, "Standard Practice of Good Workmanship in Electrical Contracting."

PART 2 - PRODUCTS

- 2.1** Provide products, components and materials which are listed and labeled by Underwriters Laboratories (UL).Test

2.2 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

- 3.1** Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair.

3.2 SUPPORTS

- A. Provide the design, fabrication, and erection of supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment.
- B. Provide members welded to structural members equal to the specification for the main structural member. Provide "simple beam" type framing with end connections welded or bolted for shear loads. Use cantilevers only when detailed or specifically approved by the Engineer. The Engineer's approval is required for location of supplementary framing.
- C. Design framing members for their actual loads, with allowable stresses specified by AISC, without excessive deflection and with consideration for rigidity under vibration, in accordance with standard structural practices.
- D. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.3 WIRING DEVICE LOCATION

- A. Position of Outlets: Center all outlets with regard to paneling, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed. Repair or replace damaged finishes. Set outlets plumb and extend to the finished surface of the wall, ceiling, or floor without projecting beyond same. Install symmetrically all receptacles, switches, and outlets shown on the trim or casework. Where necessary set the long dimension of the plate horizontal, or ganged in tandem.
- B. Mounting heights, to center of box above finished floor, shall be as follows, unless otherwise indicated. Other mounting heights are indicated on the drawings by detail or by a plus dimension shown adjacent to the symbol:

Switches	46 inches
Receptacles and similar devices	18 inches

3.4 IDENTIFICATION

- A. General
 - 1. All electrical equipment and devices shall be identified by nameplates or labels.

2. Nameplates - Shall be 4" x 1" x 1/8" thick white core, black face, plastic with engraved letters. Attachment to equipment shall be done by means of screws.
 - a. Nameplates shall be used for all major equipment such as switchboards, motor panelboards, motor control centers, transformers, panelboards (lighting, power and auxiliary) on each switch and starter in each panelboard and motor control center, disconnect switches, relays/contactors, loose mounted motor starters, and on control panels serving fire alarm, security and public address system and motor circuits.
3. Labels (Stencils) - Shall be Brady or Westline and shall be color coded in accordance with ASA-Z34-1-53 "SAFETY COLOR CODE" to include system voltage, abbreviations of service, etc. For example: "Fire Alarm", "120/208V", etc.
 - a. In general, all exposed feeders, conduits, raceways, pull boxes, and junction boxes shall be identified.
 - b. For conduit systems installed for future wiring installations, all conduits and pull boxes, both exposed and above ceiling, shall be identified.
 - c. Labels shall be used on all bare or smooth painted surfaces. For rough textured surfaces, such as wrinkle painted surfaces or plastic materials where sticking labels would not be permanent, stencils or screwed on letters shall be used.
4. Label all low voltage wiring at both ends with Brady tags. Identify data and telephone cables by cable number and document on As-Built documents.

B. Equipment Identification

1. Switchgear, Switchboard, and Panelboard - Nameplate shall designate panel number, upstream panel and voltage. Nameplate shall be mounted on the inside of panel door when the panel is located in finished areas and on the front of door when located in mechanical equipment rooms; typewritten branch circuit connection sheet shall be inserted within the panelboard manufacturer's card holder.
2. Disconnect Switches and Motor Starters - Nameplates shall describe the equipment to be controlled and power circuit number.
3. Pushbutton Stations - Label shall identify the equipment controlled.
4. Transformers - Nameplate shall identify the equipment by plan designation, primary and secondary voltages, and KVA rating.
5. Auxiliary System Equipment - The control cabinets for auxiliary systems, such as fire alarm, P.A., intercom, program, etc., shall be identified with nameplate describing the system by designation, power circuit and voltage.
6. Fusible Switches - In addition to the nameplate, there shall be labeled on the inside of switch door, the fuse size required for equipment served.

7. Junction and Pull Boxes - Identify the function of the box such as "208 volt," "Telephone," "Fire Alarm," etc., with nameplates.

C. Raceway Identification

1. In general, all exposed feeder conduits, wireways, etc., shall be identified. Branch circuit designations shall be made only after the load balancing of the panelboards has been completed and shall be approved by Owner's representative. In general, designations shall include the area name and lighting type (e.g., Down Lights).
2. The identification labels shall be located at intervals of 50 feet or less and at every point where a conduit or raceway is entering and leaving a room.

D. Device Circuit Identification

1. Receptacles connected to emergency power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.
2. Receptacles connected to normal power shall be identified by panel name and circuit number, with labels adhered to the device cover plate.

3.5 TEST

- A. Provide the tests as outlined hereinafter and other tests necessary to establish the adequacy, quality, safety, completed status and suitable operation of each system.
- B. Balance phase currents of all distribution panels and branch circuit panels within plus or minus 10 percent variation between average phase current and measured individual phase currents.
- C. Written test record shall be supplied to the Owner to show compliance with governing codes for grounding continuity.
- D. Final Corrections: Correct promptly any failure or defects revealed by these tests as determined by the Engineer. Reconduct tests on these corrected items as directed by the Engineer.

3.6 ALTERATIONS

- A. The Owner intends to make continued use of existing facilities during the construction period. Utilities and services to existing facilities shall not be interrupted without the Owner's approval. Organize the work as to cause a minimum of interference with the normal routine activities of the facilities. Interruptions shall be scheduled at the convenience of the Owner.
- B. Remove, cap and/or relocate equipment, outlets, conduit, wire, etc., as shown and specified on drawings. Examine all existing walls designated for removal, to determine the conduit and the wiring that will require capping and/or removal, whether or not such conditions are indicated on the drawings.
- C. Lighting fixtures, switches, receptacles, telephone outlets, fire alarm outlets, special outlets, etc., which are shown on the demolition plans shall be removed.

- D. Concealed conduit for circuits which are partially or completely abandoned may remain in place. Exposed conduit for abandoned circuits shall be removed unless otherwise noted.
- E. Wiring for existing circuits which must be re-routed, or which are partially abandoned, shall be reconnected to service the remaining outlets on the circuit.
- F. Wiring for a circuit which is to be abandoned shall be removed back to the panel which supplied the circuit.
- G. Refer also to specification 260500 for demolition requirements.

3.7 CUTTING AND PATCHING

- A. Provide openings for conduit, by means of sleeves.
- B. Provide cutting required for conduits if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls or footings be cut without first obtaining written permission from the Structural Engineer.
- C. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., obtain the Owner's approval in advance of the cutting and patching.
- D. Before cutting or drilling holes in floors, verify the location of reinforcing steel bars and embedded electrical conduits to avoid cutting same. X-ray floors where necessary to verify such locations. Contact the Engineer before proceeding with cutting if such obstructions interfere with the locations of planned holes.

3.8 PAINTING

- A. Electrical equipment shall be factory finished standard color as furnished by the manufacturer. Scratches shall be touched up in the field after equipment is installed with paint which matches the original color.

END OF SECTION 26 0510

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SECTION 260519 – LOW VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes conductors, wires, cables and associated splices, connections and terminations for wiring systems rated 600V or less.

1.3 QUALITY ASSURANCE

- A. Conductors and cable shall conform to UL, NEMA WC70, NECA 120, NFPA 70 and ICEA S-95-658 requirements.
- B. Comply with NECA 120, "Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC)."
- C. Comply with NECA / AA 104, "Standard for Installing Aluminum Building Wire and Cable."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wires and Cables
 - 1. AFC Cable Systems, Inc.
 - 2. BICC Brand-Rex Company
 - 3. Cerrowire
 - 4. Colonial Wire and Cable Co., Inc.
 - 5. Encore Wire
 - 6. General Cable Corporation
 - 7. Okonite Company
 - 8. Prysmian Group
 - 9. Service Wire Company
 - 10. Southwire Company
- B. Connectors for Wires and Cables
 - 1. AMP Inc.
 - 2. General Signal; O-Z/Gedney Unit
 - 3. Tyco Electronics Corporation
 - 4. Square D Co.; Anderson
 - 5. 3M Company; Electrical Products Division
 - 6. AFC Cable Systems, Inc.

7. Erico, Inc.
8. Hubbell Power Systems, Inc.
9. ILSCO Corporation
10. Thomas & Betts Corporation

2.2 CONDUCTORS

- A. Provide copper conductors with insulation rated for 600 volts, type THHN/THWN-2 for interior use and type XHHW-2 for exterior installation.
- B. Conductors No. 10 AWG and smaller shall be solid. Conductors No. 8 AWG and larger shall be stranded.
- C. Provide single copper conductors throughout. Provide No. 12 AWG minimum branch circuit wire size. Provide No. 14 AWG for control circuits, unless otherwise specified or required by overcurrent protection.
- D. For exterior feeders or branch circuits, provide Type XHHW-2 conductors installed in underground raceways.

2.3 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for application and for service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.4 CABLES

- A. Type MC cable for health care facilities shall have separate green insulated ground conductor, as well as a bonding wire. Armored metal jacket shall have a continuous green marketing stripe. This cable shall be AFC cable systems type HFC-90, or equal.
 1. Types MC, Healthcare MC and AC cables shall not be used for Emergency Power System wiring except as permitted by NEC Article 517.
- B. Connectors and fittings for type MC cable shall be manufactured and listed for that purpose.

2.5 TYPE NOT PERMITTED

- A. The following wire and cable types are not permitted to be used:
 1. BX
 2. NM/NME
 3. TW
 4. Aluminum

PART 3 - EXECUTION

3.1 CONDUCTOR SIZES AND TYPES

- A. Wire size and insulation type entering any lighting fixture or equipment shall be as recommended by the manufacturer and as minimally required by the codes. Where no recommendation is given by the manufacturer, the wire size and insulation type shall meet the minimum rating of the wiring or terminations used in the fixture or equipment.
- B. Any 120V lighting and receptacle circuit, whose home run length from panel to first fixture or device exceeds one hundred (100) feet for 120V circuits, shall not be less than 10 gauge for the entire length of run, to minimize voltage drop.
- C. Conductor sizes for motors, equipment and feeders shall be as indicated. See Schedules on drawings.
- D. MC cable shall not be used for homeruns. Use EMT conduit for all homeruns and connection to Electrical Panels.
- E. Type MC cable may be used only for flexible connections to recessed lighting fixtures from separately mounted outlet boxes. Length shall not exceed six feet. Flexible connections shall originate at junction box that is part of the branch circuit conduit system. Flexible connections shall not be daisy-chained between light fixtures.

3.2 INSTALLATION

- A. Wire and cable shall be installed in conduit, duct, wireway, surface raceway or other raceway specified. No conductors or cables shall be installed in conduits, ducts or raceways until the raceway system has been completed and free of any dirt or water. When installing conductors, exercise due care to prevent damage to conductors and insulation.
- B. Wire 10 gauge or smaller shall be spliced, tapped or joined in outlet or junction boxes with solderless spring-type connectors. Bakelite insulated wire nuts are not approved.
- C. Conductors 8 gauge and larger shall be terminated using bolted pressure or compression type connectors. They shall be specifically designed for use with the type conductors being installed in compliance with manufacturer's recommendations.
- D. Uninsulated splices, joints and free ends of conductors shall be covered with rubber and friction tape or high dielectric polyvinylchloride Scotch No. 33 Plus electrical tape.
- E. Feeder cables shall be continuous from origin to panel or equipment termination without splices in intermediate pull or splice boxes or raceway runs. Where taps and splices are necessary, they shall be made in approved splice boxes with suitable compression type connectors.
- F. Fixture and branch circuit wiring joints in exterior junction and outlet boxes shall be made with waterproof connectors rated at 600 volts maximum (1,000 volts when enclosed in fixture or sign).
- G. Exterior branch circuit conductor splices below grade shall occur only in gasketed weatherproof junction boxes. Use split bolt connector with Okonite self-fusing tape #35,

wrapped by Scotch #33 Plus tape and sealed with 3M High Gel Re-enterable Encapsulant #8882.

- H. Coordinate wire installation with other work. Support cables in accordance with Section 260529.
- I. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary. Perform pull tension calculations and do not exceed those values.
- J. Use pulling means including fish tape, cable, rope and basket weave wire/cable grips which will not damage cable or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- K. Keep conductor splices to a minimum. Provide splice and tap connectors which possess better mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors which are compatible with conductor materials.
- L. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Make terminations so there is no bare conductor at the terminal. Bundle conductor sizes #12 and #10 together. Bundle individual circuits larger than #10 separately.
- M. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.
- N. Connect wiring devices, light fixtures, panelboard devices and other electrical equipment to the wiring systems as indicated and in accordance with manufacturer's instructions.
- O. Leave a minimum of 12" pigtail at each outlet for termination purposes.
- P. Home runs shall be in conduit. Not more than three (3) branch circuits may be grouped in one (1) homerun to a branch circuit panelboard. Derate conductors per NEC requirements and count the neutral as a current carrying conductor.
- Q. Through-wiring is not permitted for recessed lighting fixtures. Each recessed lighting fixture shall be connected by flexible metal-clad cable to a separate junction box mounted above ceiling, which may serve no more than four fixtures. This flexible cable shall be Type MC or AC cable, with ground.
- R. Through-wiring is permitted for continuous rows of surface-mounted or pendant-mounted light fixtures. Fixture rows, pendant or surface-mounted, shall be fed through a flush ceiling-mounted outlet box. Branch circuit conductors for through-wiring shall have a minimum temperature rating of 90°C, or higher, if required by lighting fixture manufacturer.

- S. Install conductors with compression type motor pigtail connectors of sizes as required for motors and mechanical equipment. Connectors shall be rated for 600V, 90 degrees C, and tin plated copper with the thermoplastic elastomer insulator.
- T. Where lugs or termination points are not sized to accommodate the wire size specified or are not listed for the conductor material, provide pin connectors rated for use with copper/aluminum conductors and terminate with a tool and die size recommended by the connector manufacturer.
- U. Keep emergency conductors independent and separate from all other conductors. Do not route emergency conductors and normal conductors in the same raceway.

3.3 FIELD QUALITY CONTROL

- A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Visually inspect all terminations are tight and proper and materials installed are in accordance with the specification section.
- B. Prior to energizing test wires and cables for electrical continuity and for short-circuits and proper phase relationship. Verify conductors are appropriately color coded.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.
- D. Torque all connections/lugs in accordance with manufacturer instructions. Where torque valves are absent, follow ANSI/NETA Standard for acceptance testing specifications.

3.4 COLOR CODING FOR PHASE IDENTIFICATION

- A. Color code secondary service, feeder and branch circuit conductors with factory applied color as follows:

<u>208Y/120 Volts</u>	<u>Phase</u>	<u>480Y/277 Volts</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- B. Phase conductors with special marking, such as in type MC cable assemblies, shall be acceptable.
- C. Conductors manufactured in only one color shall be marked with colored tape at each termination to identify each conductor as phase, neutral or ground.
- D. Ungrounded conductors supplied from more than one nominal voltage system shall be separately identified where accessible.

END OF SECTION 26 0519

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SECTION 260526 – GROUNDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits and systems. Grounding requirements specified in this section may be supplemented in other sections of these specifications.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
- C. Field tests and observation reports indicating and interpreting the test reports for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with UL 467.
- C. Listing and Labeling: Provide products specified in this section that are UL listed and labeled.
- D. Comply with NECA 331, "Standard for Building and Service Entrance Grounding and Bonding."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chance: A. B. Chance Co
 - 2. Erico, Inc.; Electrical Products Group
 - 3. Ideal Industries, Inc
 - 4. ILSCO
 - 5. O-Z/Gedney Co
 - 6. Raco, Inc
 - 7. Thomas & Betts

2.2 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings and quantities indicated are in excess of National Electrical Code requirements, the more stringent requirements and the greater size, rating and quantity indications govern.
- B. Grounding Bus: Rectangular bar of annealed copper with tapped holes and insulated spacers.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Division 26 Section 260519, Low Voltage Power Conductors and Cables. Conform to NEC Article 250, except as otherwise indicated, for conductor properties, including stranding.
- B. Material: Use only copper wire for both insulated and bare grounding conductors and similar materials.
- C. Equipment Grounding Conductors: Insulated with green color insulation, Type THW, THHN or THWN insulation.

2.4 MISCELLANEOUS CONDUCTORS

- A. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.
- B. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, except as indicated.

2.5 CONNECTOR PRODUCTS

- A. Pressure Connectors: High conductivity plated units.
- B. Bolted Clamps: Heavy duty type or Hammer Lock. Acorn clamps are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL

- A. The entire electrical system and all electrical equipment shall be grounded in strict accordance with the National Electrical Code and as shown on the drawings.
- B. The grounding system shall be continuous throughout the electrical system. Route along shortest and straightest paths possible. Avoid obstructing access or installing where they may be subjected to strain, impact or damage.
- C. Neutral conductors shall be continuous throughout the electrical system and shall be grounded only at the service neutral at the service switch, or at the center point of a transformer secondary winding for a separately derived system as indicated on the drawings.
- D. When a steel conduit contains only ground wires, the ground wires shall be bonded to the conduit at both ends of the conduit run.

- E. Cabinets, panels, boxes, appliance frames, conduits and other non-current carrying metallic objects shall be grounded as required by the National Electrical Code.
- F. Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment.

3.2 APPLICATION

- A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes and quantities of equipment grounding conductors, except where specific types, larger sizes or more conductors than required by NEC are indicated.
 - 1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:
 - a. Feeders and branch circuits.
 - b. Receptacle circuits.
 - c. Single-phase motor or appliance branch circuits.
 - d. Three-phase motor or appliance branch circuits.
 - e. Flexible raceway runs.
 - f. Armored and metal-clad cable runs.
- B. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.3 GROUNDING OF SPECIAL SYSTEMS

- A. Furnish and install a green size 6 AWG copper wire in 1/2" conduit from the data terminal board and incoming telephone service to the main switchboard ground bus. The point of connection shall be located so that it is normally visible for inspection. Provide a Telecommunications Main Grounding Busbar (TMGB) equivalent to Erico TMGB - A14L15PT; mount TMGB at 24" AFF and terminate #6 AWG ground conductor to it.
- B. Provide a green #6 AWG copper wire in 1/2" conduit from the Fire Alarm Control Panel to the main switchboard ground bus.
- C. Provide an equipment ground bus equivalent to Erico TMGB - A14L15PT adjacent to the service panelboard and provide bonding conductors from this bus to service ground, FACP, IDFs, Security System, Access Control System, CATV, Satellite, Nurse Call, and all other special systems.

3.4 SYSTEM GROUNDING ELECTRODE

- A. The grounding electrode shall be as near as practicable to, and preferably in the same area as, the grounding conductor connection to the system.

- B. A metal underground water pipe, the metal frame of the building, a concrete-encased electrode and a ground ring electrode (where present) shall be bonded together to form the grounding electrode system.
- C. Where none of the above electrodes is available, the grounding electrode shall be a "Made Electrode" as per Section 250.52 of the National Electrical Code.
- D. Where a metal underground water pipe is the only grounding electrode available, it shall be supplemented by one of the grounding electrodes specified in Section 250.52 of the National Electrical Code.
- E. A single electrode which does not have a resistance to ground of 15 ohms or less shall be augmented by one additional electrode of any of the types specified in Section 250.52 of the National Electrical Code.

3.5 EQUIPMENT GROUNDING

- A. Provide an equipment bonding jumper from the grounding terminals of switches and receptacles to the grounded box that they are mounted in, unless the device is listed for self-grounding.
- B. At motors, connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.
- C. Provide a flexible bonding strap, No. 6 AWG equivalent, across each flexible duct connection at each air handler, exhaust fan, supply fan, etc., and install to preclude vibration.
- D. Exposed non-current-carrying metal parts of transformer installations shall be connected to the equipment grounding system.
- E. Provide a flexible bonding strap, #6 AWG or equivalent, to each water heater and other piece of plumbing equipment that may become energized.

END OF SECTION 26 0526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.3 REFERENCES

- A. NECA 101- "Standard for Installing Steel Conduit (Rigid, IMC, EMT)."
- B. ANSI/NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 Materials and Finishes: Provide adequate corrosion resistance.

2.2 Provide material, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. System shall be adequate in tension, shear and pullout forces to resist maximum loads calculated or imposed with a minimum structural safety factor of four times the applied force. Minimum static design load shall be the weight of supported components, plus 200 lbs.

2.3 Anchors and Fasteners:

- A. Concrete structural elements: Use expansion anchors.
- B. Steel structural elements: Use beam clamps, spring steel clips, steel ramset fasteners, or welded fasteners.
- C. Concrete surfaces: Use self-drilling anchors and expansion anchors.
- D. Hollow Masonry, plaster, and gypsum board partitions: Use toggle bolts and hollow wall fasteners.
- E. Solid masonry walls: Use expansion anchors.
- F. Sheet Metal: use sheet metal screws.
- G. Wood elements: Use wood screws.

- 2.4** Steel strut framework: Provide 12 gauge minimum size framework similar and equivalent to B-line or Unistrut for supporting electrical enclosures where noted or where necessary for a rigid installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation", NECA 1 and 101. Space supports as scheduled in NECA 1 where Table 1 lists maximum spacings less than those listed in NFPA 70.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not drill or cut structural members.
- E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- F. Install surface-mounted equipment enclosures with minimum of four anchors.
- G. In wet and damp locations use steel channel supports to stand equipment enclosures one inch off wall.
- H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- I. Install trapeze-type supports fabricated with steel slotted support system. Secure raceways to supports with two-bolt conduit clamps.

END OF SECTION 26 0529

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes raceways, fittings and outlet boxes.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Comply with NECA 101, "Standard for Installing Steel Conduit (Rigid, IMC, EMT)."
- C. Comply with NECA 111, "Standard for Installing Non Metallic Raceways (RNC, ENT and LFNC)."
- D. Comply with NECA 120, "Standard for Installing Armored Cable (Type AC) and Metal Clad Cable (Type MC)."
- E. Comply with NECA 605, "Recommended Practice for Installing Underground Nonmetallic Utility Duct."

PART 2 - PRODUCTS

2.1 RACEWAYS (Raceways shall be new and shall bear the UL label)

- A. Electrical Metallic Tubing: Shall be cold rolled welded steel conduit, galvanized on both the outside and inside. Connectors and couplings shall be steel alloy. Setscrew connectors and couplings are approved for indoor exposed or concealed (but not encased in concrete or masonry) work only. Gland compression connectors and couplings are approved for all locations. Indenter type connectors and couplings are not approved. Connectors up to and including size 1-1/2" shall be with insulated throat. Connectors shall be terminated with a bonding type locknut and for conduit sizes 2" and larger, a plastic insulated bushing. Threaded steel insulated grounding bushings having solderless lugs shall be used where required. Comply with ANSI C80.3. Connectors shall be steel; die-cast is not acceptable.
- B. Intermediate Metal Conduit (IMC): Shall be zinc-coated steel tubing. Comply with ANSI C80.6.
- C. Rigid Steel Conduit: Shall be zinc-coated rigid steel conduit and conduit fittings. Comply with ANSI C80.1 and UL 6. Couplings and fittings shall be of the threaded type. Threadless fittings shall be used only when specific approval is given by the engineer.
- D. Use Anaconda "Sealtite" flexible, liquid-tight conduit in damp or wet locations.

- E. Surface Metal Raceways: Shall be a two-piece steel raceway with removable covers, complete with bushings, connectors, fittings and all components necessary for a complete installation. Surface Metal Raceway shall be equal to Wiremold V500/V700 series.
- F. Wireway: Shall be constructed of code gauge steel and shall be in accordance with Underwriters Laboratories Standard UL-870 for Wireways, Auxiliary Gutters and Associated Fittings. Wireway shall be lay-in type (no cross bars or straps) with hinged cover. Indoor wireway shall be constructed with knockouts. Outdoor wireway shall be raintight with no knockouts. Sheet metal parts shall be coated with a rust-inhibiting primer and a gray baked enamel finish. Hardware shall be plated to prevent corrosion. Wireway shall be of standard dimensions and sized in accordance with the National Electrical Code for the particular installation. Wireway shall be Square D "SQUARE-DUCT" or approved equivalent.
- G. Standardized color coding of conduit:
 - 1. Life Safety Branch = Red with Uncolored J-Boxes
 - 2. Critical Branch = Orange
 - 3. Equipment Branch = Yellow
 - 4. Fire Alarm = Red with Red J-Boxes
 - 5. Normal Power = Not Colored (Natural Galvanized Unfinished)

2.2 OUTLET BOXES

- A. Provide outlet boxes; pull boxes, and conduit fittings as described below. Catalog numbers shown are those of Appleton Electric Company. Steel City, National Electric Products Corp., and Racor are equally acceptable. Comply with NEMA OS-1 and FB
 - 1. Lighting Boxes (concealed) - No. 40-3/4
 - 2. Lighting Boxes (concrete) - No. OCR Series
 - 3. Lighting Boxes (exposed) - No. 4S-3/4 or 40-3/4
 - 4. Switch, Receptacle, Telephone and Junction Boxes (flush) - No. 4S-3/4 or No. 225 where separate extension or plaster ring cannot be used.
 - 5. Switch, Receptacle, Telephone and Junction Boxes (exposed) - FS Series
 - 6. Switch and Telephone Boxes (concealed in narrow mullions) - Bell Electric Co. No. 447, 448, or 449.
 - 7. Weatherproof or Exterior Boxes - FS Series with weatherproof while-in-use cast metal cover and neoprene gasket.
- B. Where space is limited, No. 4CS-3/4 handy boxes may be used for a switch, receptacle, telephone or other outlet.
- C. Provide extension and plaster rings as required.
- D. Size outlet boxes in accordance with the allowable fill permitted by the National Electrical Code.

2.3 PULLBOXES

- A. Provide code gauge galvanized sheet metal pull boxes sized as per the National Electrical Code or as shown on the drawings. Provide a removable cover on the largest access side of the box unless otherwise detailed. Where cast boxes are specified, provide conduit entrances with threaded hubs. Provide stainless steel screws in all exterior locations and in wet or damp locations.

2.4 CONDUIT FITTINGS

- A. UL-514B, NEMA FB-1 and NEMA TC-3 listed. Steel material, die-cast is not acceptable.
- B. EMT Couplings:
 - 1. Series 95T gland compression (all locations).
 - 2. Steel material, die-cast is not acceptable.
- C. EMT Connectors:
 - 1. Series 86T gland compression (all locations)
 - 2. Steel material, die-cast is not acceptable.
- D. Insulating Bushings (1-1/4 inch rigid conduit and larger) - Series BBU
- E. Straight Box Connectors (flexible conduit) - Series 728 9V
- F. Angle Box Connectors (flexible conduit) - Series 738 2V
- G. Sealing Gland Assembly - OZ, Type FSK
- H. Expansion Joints - OZ, Type AX or TX with bonding jumpers and clamps.
- I. Expansion and Deflection Fittings - OZ, Type DX
- J. Cast Metal Conduit Fittings - Crouse-Hinds, Condulets form 7 with wedge nut cover.

PART 3 - EXECUTION

3.1 RACEWAYS - GENERAL

- A. Install all wiring, including telephone, low voltage, etc., in raceways as indicated on the plans and in this specification.
- B. Install raceways concealed, except in mechanical equipment rooms or where indicated on the plans.
- C. Minimum raceway size shall be 3/4" for interior applications and 1" for exterior applications.

3.2 APPLICATION

- A. Conduits located exposed in unfinished spaces, concealed inside shafts or column enclosure and all homeruns shall be EMT. PVC shall be used in concrete slabs, but last elbow out of floor slab shall be IMC. Minimum 2" concrete above conduit.
- B. Surface Metal Raceway shall only be utilized in finished spaces with hard ceilings and/or walls where concealment is not feasible. Use of surface metal raceway shall be minimized and approved by the owner.
- C. Conduits run horizontally between boxes containing wiring devices in walls shall be either EMT or metallic flexible conduit. The maximum length of metallic flexible conduit between wiring devices in furred walls shall be ten (10) feet. All other horizontal conduit in furred walls shall be EMT.
- D. Exterior conduits exposed above grade shall be galvanized rigid steel, 1" minimum.
- E. PVC Conduit will be used for underground electric circuits less than 600 volts that are:
 - 1. Under paved areas and areas scheduled to be paved.
 - 2. Next to permanent buildings, under formal planting beds and in extremely high traffic (vehicular and pedestrian) areas that would be difficult to excavate due to regular heavy use.
 - 3. All other applications 277 volt or less may be direct buried if approved by the project manager.
 - 4. If direct buried, 24 inches of cover is required unless approved by the Project Manager.
 - 5. A red plastic tracer tape is to be buried 12" above the conduit in all installations.
- F. PVC conduit shall be a Schedule 40 minimum weight unless otherwise indicated, and shall be designed for the electric application, with all connections solvent welded.
- G. Elbows for rigid metal conduit, 3 inches and larger, shall be either plastic coated or tape coated (for corrosion control) rigid metal conduit to prevent damage from pulling ropes. Rigid metal conduit shall be used for at least the first 5 feet of horizontal run out from the building.
- H. Conduits for connection to vibrating equipment such as motors, transformers, etc., shall be weatherproof Sealtite shall be used in damp or wet locations.
- I. Any type of conduit or raceway that is specifically labeled on the plans shall take precedence over the specification. Obtain written permission from the Engineer for any other deviation from the specification requirements.
- J. Non-metallic conduit or boxes will not be used on the interior of a building unless approved in writing by the Project Manager prior to construction. In cases where they are used, conduit 2" and smaller will be a minimum of Schedule 80.

- K. Keep emergency and normal raceways separate and follow separate routes. Normal and emergency conductors shall not be installed in the same raceway.

3.3 INSTALLATION

- A. Continuity. Provide metallic raceways continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes. Enter and secure conduit to all boxes to provide electrical continuity from the point of service to outlets. Provide double locknut and bushing on terminations of metallic conduits.
- B. Raceways Exposed. Run exposed raceways in straight lines at right angles or parallel with walls, beams or columns.
- C. Sleeves: Sleeves through floors and walls shall be not less than three diameters on centers. Conduit sleeves in floors shall be steel and shall extend 3 inches above the finished floor and flush with the underside of the floor slab. Size sleeves to provide ¼" annular clear space (interior sleeves) or 1" (exterior sleeves) between sleeve and raceway.
- D. Sealing of Sleeves: Openings and sleeves through which a conduit passes in non-fire rated walls, floors, and ceilings shall be properly sealed after the conduit is installed to prevent transmission or leakage of liquids, smoke, and sound. Conduit passing through drywall construction or sleeves shall be sealed both sides of the opening shall be caulked with a resilient non-hardening caulking such as U.S.G. Acoustical Sealant, Tremco, or approved equal. Coordinate closely with Division 7 contractor.
- E. Sealing of Sleeves: Conduit passing through fire rated floors, walls and ceilings shall be sealed by a UL Listed System with hourly rating equivalent to fire rated floors, walls or ceilings. Fire proofing materials by S.T.I., U.S.G., Tremco, 3M and Hilti must be installed according to UL Listed Systems. Coordinate closely with Division 7 contractor.
- F. Sleeves for fire rated walls and ceilings where data, voice, etc., cables penetrate fire walls or fire rated ceilings provide a fire stopping system as manufactured by STI EZ-Path, Wiremold FlameStopper or equal. Fire stopping system shall be UL classified and FM approved in accordance with ASTM E814 (UL1479).
- G. Raceways through Exposed Roof: Where raceways penetrate the roof seal, provide suitable pitch pockets of lead flashing or flexible boot-type flashing units applied in coordination with roofing work.
- H. Raceways Entering the Building Below Grade: Provide raceways with stainless steel plates and hardware with EDPM or NBR links and wall entrance mechanical sleeve seals having a water tight sealing gland assembly where the raceways enter into a dry area. Use OZ Gedney type FSK or equivalent seal. Following installation of conductors, cables and pull tapes in raceways, provide water stop inside conduits equivalent to Tyco RDSS and RDSS-Clip inflatable sealing bladders.

- I. Bends. Where more than one conduit in a bank of exposed conduit changes direction, all bends shall be concentric. Conduit bends shall not be less than standard radius. Conduit bends for power feeders over 600 volts and for telephone feeders shall be long radius.
- J. Threads. Clean all threads of rigid conduit. Coat all male threads of all steel conduit installed underground or in or under concrete slabs with teflon immediately before being coupled together.
- K. Running Threads. Use "Erickson" type couplings in lieu of running threads.
- L. Protection. Cap raceways stubbed up, including those in cabinets, immediately upon their installation. The use of paper or rag wads will not be permitted.
- M. Conductors carrying more than 150V to ground will not be installed in conduits with conductors carrying less than 150V to ground
- N. Expansion Joints. Provide raceways crossing expansion joints with Type BJ bonding jumper for bonding conduit or tubing together. Where differential settlement may occur, use deflection fittings.
- O. General Location Requirements. Raceway runs shown are diagrammatic. Determine exact locations in the field except where otherwise noted or where dimensions are specified on the drawings. Conduits shall not run within 12 inches of pipes carrying hot liquids, steam, or gases.
- P. Pull Tapes. Empty conduits shall be provided with a pull tape.
- Q. Provide accessories as required for a complete installation, including insulated bushings and inserts where required by the manufacturer or NEC. Provide insulated bushings on all conduit stub-ups, where conduit does not terminate in a box or enclosure, and on all enclosure openings where cables enter or exit unprotected by conduit.
- R. Install no more than the equivalent of three 90-degree bends in any conduit run except for communication conduits. Communications conduits shall have a maximum of two 90-degree equivalent bends for each raceway. Communication conduits 3/4" and less shall be installed in maximum lengths of 50 feet and 1" and larger at 75 feet maximum lengths.
- S. Identification of conduit shall be provided for all conduit:
 1. Raceway Labeling: Provide labeling on conduits indicating electrical distribution system contained within (e.g. Normal, Life Safety, etc.) and operating voltage level. Label size shall be as follows:

Nominal EMT conduit size	Nominal RGS conduit size	Length of color background on label	Height of letters
up to 1 inch	up to 3/4 inch	8 inches	1/2 inch
1.25 to 1.5 inches	1 to 1.5 inches	8 inches	3/4 inch
2 to 5 inches	2 to 5 inches	12 inches	1.25 inches
6 inches	6 inches	24 inches	2.5 inches

- a. Normal Power = Black Lettering on White Background

- b. Life Safety Branch = White Lettering on Red Background
- c. Equipment Branch = Black Lettering on Yellow Background
- d. Critical Branch = Black Lettering on Orange Background

3.4 RACEWAYS SUPPORTS

- A. Refer to Section 260529 – Hangers and Supports for Electrical Systems.

3.5 JOINTS AND CONNECTIONS

- A. Metal Conduits. Make watertight all couplings and threaded connections in threaded conduit. Cut all joints square, ream smooth, and properly thread. Fit all box connections with a minimum of two approved locknuts and one steel, plastic or fiber bushing forming an approved tight bond with box. Provide locknuts both inside and outside of the enclosure to which the conduit is attached. Use rain tight compression type fittings for electrical metallic tubing systems and use at least one locknut on the inside of each enclosure entry. Provide grounding locknuts or bushings where required in Section 260526 Grounding Systems.
- B. PVC Conduits. Make watertight all couplings and connectors in conduit runs. Utilize solvent cement joints of a type approved by the manufacturer for all couplings and fittings. Provide adapters and locknuts where conduit is attached to metal junction boxes, panels, etc.
- C. Join raceways with fittings designed and approved for the purpose and make joints tight. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight. Use insulating bushings to protect conductors.
- D. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box.
- E. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- F. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor in flexible connections.

3.6 BOX APPLICATIONS

- A. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
 - 1. Interior Dry Locations: Sheet steel, NEMA type 1.
 - 2. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.

- 3. Wet Locations: NEMA type 4X enclosures.
- B. Through-wall boxes are not permitted. Offset back-to-back boxes in the same wall not less than 3". If boxes are in fire rated partitions, offset boxes a minimum of 24" or provide fire rated "putty pads" on boxes. If boxes are in the same stud cavity and open to opposite sides of the wall, provide "putty pads" on boxes.
- C. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location, except as otherwise indicated.

3.7 OUTLET BOX INSTALLATION

- A. Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Support and fasten items securely in accordance with Division 26 Section "Supporting Devices."
- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.
- F. Mounting: Mount outlet boxes for switches with the long axis vertical. Mount boxes for receptacles vertically. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not cover different types of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges.
- G. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 1-1/2 inches deep, minimum.
- H. Protect outlet boxes to prevent entrance of plaster and debris. Thoroughly clean foreign material from boxes before conductors are installed.

END OF SECTION 26 0533

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SECTION 260620 – TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This Section includes automatic transfer switches rated 600 V.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections:
 - 1. Shop drawings or published product data for each transfer switch, including dimensioned plans, sections and elevations showing minimum clearances, conductor entry provisions; gutter space; installed features and devices and materials lists.
 - 2. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.
 - 3. Single-line diagrams of transfer switch units showing connections between automatic transfer switch, by-pass/isolation switch, power source and load, plus interlocking provisions.
 - 4. Operation and maintenance data for each type of product, for inclusion in Operating and Maintenance Manual specified in Division 1.
 - 5. Manufacturer's certificate of compliance to the referenced standards and tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, as indicated and as specified in paragraph "Tested Fault Current Ratings."

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms experienced in manufacturing equipment of the types and capacities indicated and have a record of successful in-service performance.
- B. Emergency Service: Manufacturer shall maintain a service center capable of providing emergency maintenance and repairs at project site with an 8-hour maximum response time.
- C. Comply with NFPA 70, "National Electrical Code," for components and installation.
- D. Comply with NFPA 110, "Standard for Emergency and Standby Power Systems."
- E. Comply with NEMA ICS 1, "General Standards for Industrial Control," ICS 2, "Industrial Control Devices, Controllers and Assemblies," ICS 6, "Enclosures for Industrial Controls and Systems" and ICS10, "AC Automatic Transfer Switches."

- F. IEEE Standard 446, "Emergency and Standby Power," The Orange Book.
- G. UL Listing and Labeling: Items furnished under this section shall be listed and labeled by UL for emergency service under UL Standard 1008.
- H. Single-Source Responsibility: Obtain ATSS, BP/ISS, remote annunciators and remote annunciator and control panels from a single manufacturer that assumes responsibility for all system components furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Automatic Switch Co. (ASCO)

2.2 TRANSFER SWITCH PRODUCTS, GENERAL

- A. Number of Poles and Current and Voltage Ratings: As indicated.
 - 1. Units smaller than 600 amperes shall not have different current ratings for different classes or mixtures of loads, including 100 percent tungsten filament lamp or 100 percent inductive load.
 - 2. Units 600 amperes and larger shall have current ratings that apply to mixtures of loads including 30-percent-maximum tungsten filament lamp load.
- B. Tested Fault-Current Withstand and Closing (WCR) Ratings: Withstand and closing ratings shall exceed the indicated available rms symmetrical fault current at the equipment terminals based on testing according to UL Standard 1008, conducted at full-rated system voltage and 20 percent power factor. Rate each product for withstand duration time as follows when tested for rated short-circuit current correlated with the actual type of circuit protective device indicated for transfer switches for this project. WCR shall be based on use of the same set of contacts for the withstand test and the closing test.
 - 1. Transfer switch(es) shall have a time duration Withstand and Closing Rating (WCR) of at least 0.05 seconds (3 cycles at 60 Hz).
 - 2. Short-time WCR shall be rated for a duration of 0.5 seconds (30 cycles at 60 Hz).
 - 3. Transfer switches(es) with Withstand Ratings only and without Closing Rating shall not be acceptable. This applies for Short-Time and Time Duration WCR Ratings.
- C. Annunciation and Control Interface Components: Devices at transfer switches for communicating with remote annunciators or annunciator/control panels shall have communications capability matched with the remote device.
- D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20°C to 60°C.

- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage surge withstand capability requirements when tested according to ANSI C37.90.1, IEEE Guide for Surge Withstand Capability (SWC) Tests. Components meet or exceed voltage impulse withstand test of NEMA ICS 1.
- F. Neutral Terminal: Where 2- or 3-pole switches are indicated, provide fully rated, solid, unswitched neutral terminal except as indicated.
- G. Four-Pole Switches: Where 4-pole switches are indicated, provide full-capacity neutral switching.
- H. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated shall be double the nominal rating of the switch.

2.3 CONSTRUCTION

- A. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in both positions.
- B. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load.
- C. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent interphase flashover. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
- D. Transfer switches designated on the drawings as 4-poles shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Equipment using add-on accessory overlapping contacts are not acceptable.
- E. Transfer switches which are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs, sized to carry 100% of the current designated on the switch rating.
- F. Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking. Controls on cabinet door shall be key-operated.
- G. Transfer switches shall be mounted in enclosures as designated on the drawings. Separate enclosures shall be the NEMA type specified. The cabinet shall provide required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

2.4 AUTOMATIC CONTROLS

- A. Transfer switches that are designated on the drawing as automatic shall be provided with a fully automatic control system, and provisions for manual operation as described in this section.
1. Control shall be solid-state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 472, NEMA ICS-109.21 and IEC 801-2, 3 and 4. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.
 2. Solid-state under voltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.
 3. Controls shall be provided with a solid-state over and under frequency sensor to monitor source(s). Pickup bandwidth shall be adjustable from a minimum of +/-4% to a maximum of +/- 20% of nominal frequency. Dropout shall be +/-5% of nominal wider than pickup frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec. Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid-state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.
 4. Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.
 5. The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.
 6. The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.
 7. Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.
 8. Power for transfer operation shall be from the source to which the load is being transferred.
 9. The control shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time, as follows:
 - a. Source 1 OK
 - b. Start Gen Set
 - c. Source 2 OK
 - d. Transfer Timing

- e. Transfer Complete
 - f. Retransfer Timing
 - g. Retransfer Complete
 - h. Timing for Stop
10. Transfer switches shall be equipped with a field adjustable controls to allow the operator to control the transfer switch operating time during switching in both directions. The controls shall control the time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The transfer switch operating speed control feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor is not an acceptable substitute for this feature.

2.5 FRONT PANEL DEVICES

- A. Provide devices mounted on cabinet front consisting of:
- 1. A key-operated selector switch to provide the following positions and functions:
 - a. Test - Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.
 - b. Normal - Normal operating position.
 - c. Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.
 - 2. Transfer switch position and source available lamps.

2.6 ACCESSORY ITEMS

- A. Transfer switches shall be equipped with accessories as follows:
- 1. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.
 - 2. Manual Selector Switch: Provide a manual/automatic retransfer selector switch to provide either automatic retransfer after the retransfer time delay, or a manual retransfer when selected by an operator.
 - 3. Elevator Pre-Transfer signal form C relays (Elevator Control Timer on Normal and Elevator Control Timer or Emergency) connected to elevator controller.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting of Switches: Level and anchor the unit to the wall, if wall mounted type. If floor mounted type, provide a 4" high housekeeping pad. Pad shall be 1" larger in each dimension than equipment to be placed on pad. Pad to be rated for seismic conditions, level and anchor the unit to the pad.
- B. Identify components according to Division 26 Section "Basic Electrical Materials and Methods."

- C. Installation shall comply with applicable state and local codes as required by the Authority Having Jurisdiction (AHJ). Install equipment in accordance with manufacturer's instruction and instructions included in the listing and labeling of the UL listed products.
- D. Installation of equipment shall include furnishing and installing all interconnecting wiring between components of the on-site power system.

3.2 WIRING TO REMOTE COMPONENTS

- A. Match type and number of cables and conductors to control requirements of transfer switches used. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Provide connection to elevator controllers for pre-transfer signal (Elevator Control Timer).

3.3 CONNECTIONS

- A. Tighten factory-made connections, including connectors, terminals, bus joints, mountings and grounding. Tighten field-connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.4 ADJUSTMENTS

- A. Transfer switch units are shipped with time delay settings preset at factory. Field adjust these settings to correspond to field conditions.
- B. Coordinate time delay settings with Owner to correlate with other settings of emergency electrical system equipment, either new or existing.

3.5 GROUNDING

- A. Make equipment grounding connections for transfer switch units as indicated and as required by the NEC.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise field tests. Coordinate scheduling of tests with Owner's Representative at least three weeks prior to the tests.
- B. Preliminary Tests: Perform electrical tests as recommended by manufacturer and as follows:
 - 1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester. Include external annunciator and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
 - 2. Check for electrical continuity of circuits and for short circuits.

- C. Field Tests: Give 7 days' advance notice of tests and perform tests in presence of Owner's representative.
- D. Coordinate tests with tests of generator plant and run them concurrently.
- E. Tests: As recommended by manufacturer and as follows:
 - 1. Contact Resistance Test: Measure resistance of power contacts for automatic transfer switches, non-automatic transfer switches and bypass/isolation switches. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.
 - 2. Operational Tests: Demonstrate interlocking sequence and operational function for each switch at least 3 times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate low phase-to-ground voltage for each phase of normal source to automatic transfer switches.
 - c. Verify time-delay settings and pickup and dropout voltages.
- F. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets specified requirements.
- G. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistance and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.7 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted in conjunction with representatives of the manufacturer. The Engineer shall be notified in advance and shall have the option to witness the tests.
- B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one-step rated load pickup test in accordance with NFPA 110 for the generator set and ATS. Electrical contractor shall be responsible to provide fuel for the genset to complete all testing and refill the genset tank upon test completion.
- C. Coordinate test times with owner's representative and maintain emergency system availability for the other buildings on site.

END OF SECTION 260620

SECTION 26 0500 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.
- B. Section 260500 – Common Work Results for Electrical Systems
- C. Section 260510 - Basic Electrical Materials and Methods

1.2 SUMMARY

- A. Furnish and install new lighting fixtures as shown on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

- A. Fixtures and components shall be U.L. listed and meet applicable national and local code requirements for the particular application. Fixtures shall bear the UL label.
- B. Comply with applicable ANSI, UL and NEMA standards including, but not limited to, the following:
 - 1. Lamps: ANSI C82.11 and C82.4.
 - 2. NECA / IESNA 500, "Standard for Installing Indoor Lighting Systems."
 - 3. NEMA SSL-1-10, "Electronic Drivers for LED Devices, Arrays, or Systems."

1.4 SUBMITTALS

- A. Product Data: For each type of light fixture including dimensions, features, accessories, ballasts, weights and supports.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Lighting equipment is shown in the fixture schedule on the drawings to establish general requirements. The fixture manufacturers' catalog numbers are not to be construed as all inclusive. Equivalent products manufactured by Columbia, Cooper, Daybrite, Hubbell, Kurt Versen, Lithonia, Lightolier, Prescolite or Williams are considered equivalent. Furnish and install accessories or hardware required for a complete installation. Light fixtures shall be equipped with proper accessories, lenses, louvers, reflectors, shields, hangers, clips, frames, lamps, ballasts, and other components essential for proper installation in or on walls, ceilings or other construction features, and shall be properly painted for protection and preservation appropriate to the place installed.
- B. Refer to the Room Finish Schedule on the Architectural drawings to verify the type of ceiling construction. Fixtures specified in the Fixture Schedule are based on the ceiling construction contemplated at the time of design. Final ceiling construction may be different than the type

specified. EC shall confirm the ceiling construction with the General Contractor and Owner's Representative prior to construction. Provide fixtures with the proper hardware for installation in or on the specified ceiling.

- C. All fixtures shall bear a U.L. Listing.

2.2 FIXTURES AND FIXTURE COMPONENTS

- A. Metal Parts: Free from burrs, sharp corners and edges along with any metal parts shall be painted after fabrication.
- B. Sheet Metal Components: Steel, except as indicated. Formed and reinforced to prevent warping and sagging.
- C. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position. Door frames shall have captive spring latches.
- D. Reflecting Surfaces: Minimum reflectance as follows, except as otherwise indicated:
 - 1. White Surfaces: 70 percent
 - 2. Specular Surfaces: 80 percent
 - 3. Diffusing Specular Surfaces: 75 percent
 - 4. Laminated Silver Metalized Film: 90 percent
- E. Lenses, Diffusers, Covers and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 - 2. Lens Thickness: 0.125 inch (3mm) nominal; except where greater thickness is indicated.
- F. Finishes:
 - 1. Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters and similar defects.
 - 2. Finish applied on metal surfaces after forming or fabrication.

2.3 LED LIGHT FIXTURES

- A. General
 - 1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
 - 2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant and Design Lights Consortium Qualified Products.
 - 3. LED drivers shall include the following features unless otherwise indicated:

- a. Minimum efficiency: 85% at full load.
 - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - d. Integral short circuit, open circuit, and overload protection.
 - e. Power Factor: = 0.95.
 - f. Total Harmonic Distortion: = 20%.
 - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
- a. Comply with IES LM-79 and LM-80 requirements.
 - b. Minimum CRI 80 and color temperature 3500K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 - c. Minimum Rated Life: 50,000 hours per IES L70.
 - d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
 - e. Minimum luminaire efficacy of 85 lumens per watt.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures shall be installed in accordance with manufacturer's recommendations, instructions contained herein or on the drawings and field conditions.
- B. Locations of fixtures, unless specifically dimensioned on the architectural or electrical plans, may be scaled from the plans and adjusted as required to meet job conditions.
- C. Locations of light fixtures on the electrical plans are diagrammatic. Refer to Architectural Reflected Ceiling drawings for dimensional data, location and reference data including work or other trades. Coordinate installation of lighting fixtures with those drawings.
- D. Provide necessary accessories required for the support or mounting of fixtures. Where necessary, provide bridging between structural members. No fixtures shall be supported directly from the ceiling tiles or from duct work, piping or work of other trades.
- E. Recessed fixtures shall be mounted with flanges tight to the finished ceilings. Provide drywall flanges for fixtures installed in drywall ceilings.
- F. Surface and suspended fixtures shall be securely mounted to the structural system, the ceiling superstructure, or to supporting members. Surface fixtures shall be mounted in proper alignment with the ceiling. Suspended fixtures shall be mounted from vertical supports. Swivel type hangers or sloped ceiling adapter cones shall be provided on sloping ceilings.
- G. Recessed LED, fixtures shall be independently supported with a minimum of two metal channels spanning ceiling tees or ceiling support steel channels. No fixture shall be supported directly from the ceiling tile.
- H. Support for Recessed and Semi-Recessed Grid-Type LED Fixtures: Units may be supported from suspended ceiling support system with support wires at opposite corners of the fixture attached to building structure and four (4) grid clips.

1. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees. Do not support fixtures by ceiling acoustical panels.
 - I. Wall mounted fixtures shall be securely mounted with a minimum of two screws to the wall or to studs or framing within the wall to prevent the possibility of movement or misalignment.
 - J. Install remote mounted ballasts in a ventilated enclosure, which shall be secured to the building structure with vibration isolating mountings. Connections shall be thru flexible conduit. Ballasts shall be mounted in a manner which will promote heat transfer to the housing.
 - K. Adjustable fixtures shall be aimed as directed by the Architect and/or Engineer.
 - L. Install lamps in each fixture.
- 3.2** Prior to substantial completion, clean fixture lenses and reflectors and replace inoperative lamps. Replace or repair damaged or blemished fixtures.
- 3.3 SEISMIC SUPPORTS**
- A. Recessed LED fixtures installed in lay-in ceilings shall be provided with four (4) earthquake clips for securing to the restrained Tee bars. If ceiling grid is not seismically restrained, provide two (2) 12 gauge support cables on opposite corners of the fixture attached to building structure above.
 - B. Recessed LED, fixtures shall have support mounting rails screwed to the ceiling Tee bars.
- 3.4 FIELD TESTS**
- A. Test emergency lighting by interrupting power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 26 5100

SECTION 267313 – LIQUID-FILLED TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and Special Conditions shall govern work performed under this section.

1.2 SUMMARY

- A. This section includes medium voltage, 3 phase, pad mounted transformers to be installed exterior to the building.

1.3 SUBMITTALS

- A. General: Submit the following:
 - 1. Complete equipment ratings and dimensions.
 - 2. Nameplate legends.
 - 3. Seismic certification.
- B. Manufacturer's certification, signed by the manufacturer, certifying that the company complies with the specified requirements. Upon request, submit evidence of manufacturer's experience.
- C. Operating and maintenance data for transformers, for inclusion in Operating and Maintenance Manual.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer of medium voltage electrical distribution equipment to perform the installation specified in this section.
- B. Electrical Component Standard: NFPA 70 "National Electrical Code" for components and installation.
- C. IEEE Compliance: IEEE Standard C2, "National Electrical Safety Code."

1.5 DELIVERY, STORAGE AND HANDLING

- A. Coordinate delivery of transformers to a location designed by the construction project manager.
- B. Store protected from weather and so condensation will not form on or in transformer components. Provide temporary heaters in accordance with manufacturer's recommendations to prevent condensation.
- C. Handle transformers in accordance with manufacturer's instructions. Use factory installed lifting provisions.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete bases and pads. Cast anchor bolt inserts into pads necessary to comply with seismic restraint requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. ABB, General Electric
 - 2. Maddox
 - 3. Schneider Electric – Square D
 - 4. Hitachi Energy

2.2 MEDIUM VOLTAGE LIQUID-FILLED, PAD MOUNTED TRANSFORMERS

- A. Equipment must be new; re-manufactured equipment will not be accepted.
- B. Rating:
 - 1. Primary Voltage: 12.470 kV, delta.
 - 2. Secondary Voltage: 277/480 V, wye, 4-wire, 60 Hz.
 - 3. kVA Rating: 2000 kVA.
 - 4. Noise level not to exceed the levels given by NEMA TP 80050-2013.
- C. List and label as complying with IEEE C57.12.00 and IEEE C57.12.34.
- D. Efficiency: Comply with 10 CFR 431, Subpart K; registered on Department of Energy's Compliance Certification Database in accordance with 10 CFR 429.
- E. Seismic Qualification:
 - 1. Provide independent third-party testing for compliance with ICC (IBC)/ASCE 7, certifying that equipment will remain operable following design level earthquake.
 - 2. Perform shake table testing in accordance with ICC-ES AC156, using importance factor (Ip) of 1.5.
- F. Cooling Type: Transformer shall be filled with a nonflammable fluid (mineral oil is not acceptable).
- G. Primary Taps: Primary Voltage Taps shall be supplied to provide five (5) - 2.5% no load tap changes. Two 2.5 percent full capacity above normal, two 2.5 percent full capacity below normal.

- H. Impedance: Transformer efficiency shall meet all DOE 2010, 10 CFR Part 431 requirements. Percent impedance shall meet all applicable standards.
- I. Temperature Rise: Average 65 degrees C above ambient at rated kVA output.
- J. Winding insulation shall have a rating of 120 degrees C
- K. Transformer shall have ambient temperature rating of 40 degrees C.
- L. Basic Impulse Levels (BIL):
 - 1. 95 kV class.
- M. High-Voltage Terminations and Equipment: Dead-front
- N. Bushings:
 - 1. High-Voltage Dead-Front Bushings:
 - a. 600 A Bushings, 15kV for no load break bolted elbow.
 - b. Shall conform to ANSI/IEEE Standard 386 (ANSI Standard C119.2).
 - c. Shall include a semi-conductive coating. Shall be mounted in such a way that the semiconductive coating is solidly grounded to the tank.
 - d. Shall have covers in place for shipping and storage.
 - e. Three (3) - 600A primary bushing, suitable for delta connection of 15kV dead break elbow connectors.
 - 2. Low-Voltage Bushings:
 - a. Provided with blade-type spade terminals.
 - b. Suitable for Copper or Aluminum termination lugs.
 - c. Low voltage terminals shall be tinned spade having eight (8) – 9/16” holes on 1 3/4” centers for conductor connections.
 - d. Shall be supported to the top of transformer to prevent oil leaking from the bushing due to the weight of the cables attached to them.
 - e. Low voltage service conductors shall use 2-hole compression type lugs.
 - 3. Provide low-voltage neutral insulated bushing, grounded to tank by removable copper ground strap.
- U. Fusible Protection:

1. Provide internal oil bayonet expulsion fuses and in-tank, current limiting fuses sized at approximately three times full-load primary current.
 2. Bayonet fuses shall be removable with a hot stick.
 3. Current limiting fuses shall have an interrupting capacity greater than 40,000A.
 4. Fusing combination shall provide full range protection for low and high current faults.
 5. Three spare bayonet fuses shall be supplied with the transformer. (This totals six bayonet fuses per transformer.)
- V. Surge Protection:
1. Provide three 15kV rated, 8.4kV MCOV, elbow type arrestors.
 2. Transformer must have provisions for lightning arrestors.
- W. Transformer Cores:
1. Construct of high-grade, grain-oriented, nonaging silicon steel with high magnetic permeability and low hysteresis and eddy current losses.
 2. Magnetic Flux Densities: Maintain well below saturation point.
- X. Transformer Coils Winding Material: Copper.
- Y. Neutral Conductor
1. Sized to handle up to 2 times the rated phase current continuously.
- Z. Grounding:
1. Three grounding connections, each with two (2) ½"-13 UNC tapped holes
 - a. Primary compartment
 - b. Secondary compartment
 - c. Outside of the enclosure on the tank
- AA. Enclosures:
1. All exterior surfaces shall be designed to prevent the holding or pooling of water or liquids.
 2. The transformer shall have high and low voltage compartments assembled side by side as an integral unit with no live parts accessible without opening the compartment doors.

3. Depth of compartment shall be 24 inches minimum.
4. The high voltage compartment shall be located on the left.
5. High voltage compartment shall be separated from the low voltage compartment by a metal barrier.
6. No bolts, screws or other fastening devices shall be externally removable.
7. There shall be no openings where sticks, rods or other devices could be inserted and contact live parts. Enclosure shall be tamper proof.
8. Compartments shall limit water entry.
9. A clear, non-conductive, hinged barrier with latching mechanism shall be installed in the low voltage compartment in a manner which will completely restrict access to the low voltage compartment with barrier in closed position. Barrier shall be clearly marked "Danger Arc Flash Hazard".
10. The secondary door shall include provisions for a lock, which must be removed to remove the penta-head bolt.
11. The primary door shall be separate and interlock with the secondary door in a manner, which the secondary door must be opened first before the primary door can be opened.
12. The primary door shall also be secured by penta-head bolts other than the bolts securing the secondary door.
13. Construction: Sealed tank of sufficient strength to withstand pressure of 7 psi without permanent distortion; provide welded cover and tamper-resistant handhole coverings.
14. Tank and Compartment: Comply with IEEE C57.12.28 or IEEE C57.12.29; limit disassembly, breakage, and prying open of doors, panels, and sills with doors in closed and locked position.
15. Maintain tank seal for top oil temperature range of 23 degrees F (minus 5 degrees C) to 221 degrees F (105 degrees C).
16. Provide lifting eyes and jacking pads.

BB. Markings and Labeling:

1. Provide engraved nameplate.
 - a. In addition to normal information, the following items shall be included on the nameplate of each unit:
 - 1) kVA ratings

- 2) Primary voltage
 - 3) Secondary voltage
 - 4) BIL ratings
 - 5) Temperature ratings
 - 6) Primary and Secondary voltages for each tap setting
 - 7) Date of Manufacture.
 - 8) Name of Manufacturer.
 - 9) Transformer K factor (if rated)
 - 10) Type of conductor in windings.
 - 11) Impedance expressed in percentage.
 - 12) Delta - wye or delta -delta diagram detailing the relationship of primary to secondary bushings.
 - 13) Statement "Transformer filled with less-flammable fluid".
 - 14) Statement "Transformer filled with fluid containing no detectable PCB's at time of manufacture."
 - 15) Total weight of unit expressed in pounds.
 - 16) Weight of unit without oil.
2. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards. Transformer shall have a "Danger-High Voltage" label on the outside of the primary compartment door meeting all applicable standards
 3. Transformer shall have "Secondary Barrier Installed" label installed on the outside of the secondary compartment door.
 4. Transformer shall have a blue "CONTAINS NO PCB's" label placed inside of the secondary compartment door and another same label placed on the outside of the tank

CC. Paint:

1. Munsell green #7.0GY3.29/1.
2. Minimum Thickness of 2.5 MIL
3. A small container of touch up paint shall be supplied with the transformer and given to facility's maintenance staff.

DD. Provide the following accessories:

1. Liquid level indicator shall be supplied and located inside the low voltage compartment.
2. 1 inch (25 mm) drain valve with sampling device installed in the primary compartment.
3. Pressure relief valve.
 - a. Qualitrol series 201 pressure relief valve or approved equal for NEC code 450-23 application
4. Temperature indicator shall be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install transformer in accordance with manufacturers' written instructions and the following specifications.
- B. Care shall be taken not to damage the switchgear during moving and installation.
- C. There shall be an 8 foot long, level, clear area in front of doors to allow for safe operating and maintenance.
- D. The transformer shall be bolted down to the pad per manufacturer's recommendations.
- E. Cable connections shall be torqued to manufacturer's recommendations.

3.2 CONCRETE BASES

- A. Provide concrete pad per detail on drawing.

3.3 IDENTIFICATION

- A. Provide install all nameplates and labels as specified.

3.4 GROUNDING

- A. Grounding of Switchgear Components: As specified in Division 26 Section, "Grounding."
- B. Grounding Connections: Ground equipment to main electrical ground bus indicated. Provide maximum 5-ohm ground resistance at transformer location. Install ground rod at transformer and make exothermal weld at ground rod to bonding conductor.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to supervise the assembling and connecting of components, pretesting of switchgear and adjusting of switchgear components.
- B. Test continuity transformer impedance.
- C. Perform TTR, Megger, and Ground testing prior energizing the transformer.
- D. Set the proper tap on the transformer and energize the transformer to check for proper voltage.
- E. Send engineer record of test results after all adjustments and corrections have been made.

3.7 COMMISSIONING

- A. Remove temporary lifting eyes, channels, and brackets.

END OF SECTION 267313

SECTION 311000 – SITE CLEARING & DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Removal of drainage structures, pavements, surfacing, base courses, curb, curb and gutter, sidewalks, steps, buildings, foundation walls, utility pipes, and other existing improvements as noted on the drawings.
- B. It is the intent that the demolition be complete and adequate for the intended purpose. This work shall include the removal of all items, whether in view or hidden underneath the surface of the ground, regardless of whether shown on the drawings or encountered during construction.

1.2 PERMITS

- A. Contractor shall comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess waste materials.
- B. Contractor shall obtain and pay for all required inspections, permits, and fees.

1.3 SUBMITTALS

- A. The contractor shall submit demolition and clearing procedures and operational sequences and schedules for review and acceptance by the Owner's representative.

1.4 GENERAL PROCEDURES

- A. Erect barriers, fences, guardrails, enclosures, chutes, and/or shoring to protect personnel, structures and utilities remaining intact.
- B. Protect on-site trees and plants noted on drawings. All landscaping and trees outside of construction limits are to be protected from damage.
- C. Protect all existing objects intended to remain. In case of damage, make repairs or replacements necessary at no additional cost to the owner.
- D. Minimize interference with roads, streets, driveways, sidewalks, and adjacent facilities.
- E. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
- F. If closure is permitted, provide signage indicating closure and signage to direct traffic to alternate route.

- G. Moisten surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

PART 2 - EXECUTION

2.1 PREPERATION

- A. Notification: Provide the owner's representative a minimum of two business days' notice prior to commencing work of this section.
- B. The contractor shall locate existing utility lines and services traversing the site and determine the requirements for their protection. The contractor shall preserve active utilities on the site that are designated to remain.
- C. Before starting site operations, the contractor shall disconnect or arrange for the disconnection of all utility services designated to be removed. The contractor shall perform all such work in accordance with the requirements of the utility company or agency involved

2.2 PAVEMENTS

- A. In removing pavement, curb and gutter, sidewalks, etc., where a portion is left in place, removal shall be to an existing joint or to a joint sawed to a minimum depth of 2" with a true saw line and a vertical face. Remove sufficient pavement to provide for proper grade and connections in the new work regardless of any limits indicated on the drawing.

2.3 SEWERS

- A. Existing castings and culverts, if salvageable and removed intact, remain the property of the contractor.
- B. All drainage pipes, which have been or are to be abandoned, shall be permanently sealed at the ends with bulkheads constructed of concrete, having a minimum thickness of 8".
- C. Abandon storm sewer structures by breaking the concrete bottom of the structure into pieces no larger than 12" in any direction and removing the top of the structure to 3' below finished grade. Plug all pipes with concrete and fill structure with 1" clean gravel.

2.4 BLASTING

- A. Blasting is not permitted.

2.5 DISPOSAL

- A. All debris shall be disposed of off-site
- B. Do not store or burn materials on-site.

- C. All asphalt or concrete materials shall be disposed of off-site.
- D. Material acquired through demolition, other than those required to complete the construction project and designated for return to owner, will become the property of the contractor and will be removed from the site and off University property. The material will be disposed of in a legal manner.
- E. Abated items will be disposed of per Section 02 8000.
- F. Refer to Section 01 7419 for further direction related to diversion and tracking.

2.6 CONSTRUCTION LIMITS

- A. The Contractor's operations shall be restricted to those areas inside the construction limits indicated on the drawings. If limits are not indicated, restrict work to the owner's property, easement, or public rights-of-way.
- B. Complete work within public rights-of-way under the permission of the governing agency.
- C. The Owner will place the top lift of soil (6" topsoil) and will do the surface restoration.
- D. The contractor shall repair damage outside the construction limits at no additional expense to the owner.

2.7 UTILITY ADJUSTMENT

- A. The contractor is responsible for the adjustment of all gas vents, manholes, castings, and water valves within the grading limits to match the finished surface.
- B. Adjustments shall be coordinated with the utility companies and the cost for all adjustments shall be incidental to construction unless noted as a bid item.
- C. The contractor shall repair any damage to utility structures and appurtenances that occurs during construction at no additional cost to the owner.

END OF SECTION 311000

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SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide earthwork operations. The Contractor shall be responsible for the excavation of all footings and foundations in addition to preparing the pavement subgrade. The Contractor shall extend all utility excavations and services and make final, permanent connections to utility services as required.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Test Reports: Submit for approval test reports, list of materials and gradations proposed for use. **Obtain samples of any proposed fill material and contractor to provide standard proctor test reports to engineer. Supply in-place compaction reports from an independent testing service for all fill materials placed.**

1.3 QUALITY ASSURANCE

- A. Compaction:
 - 1. Under structures, building slabs, steps, pavements, and walkways, 95 percent Standard Proctor minimum density, ASTM D 698.
 - 2. Under lawns or unpaved areas, 85 percent, ASTM D 698.
- B. Grading Tolerances Outside Building Lines:
 - 1. Lawns, unpaved areas, and walks, plus or minus 1 inch.
 - 2. Pavements, plus or minus 1/2 inch

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Earthwork:
 - 1. Application: Excavation, filling, compacting and grading operations both inside and outside building limits as required for below-grade improvements and to achieve grades and elevations indicated. Provide trenching and backfill for mechanical and electrical work and utilities. Note: all graded gravel or crushed stone shall be provided by the Contractor.
 - 2. Application: Subbase materials, drainage fill, common fill, and structural fill materials for slabs, pavements, and improvements.
 - 3. Application: Suitable fill from off-site if on-site quantities are insufficient or unacceptable, and legal disposal of excess fill off-site.
- B. Acceptable Materials
 - 1. Subbase Material: MoDOT Type 5 Base Rock. Waste lime is not a suitable material.

2. Drainage Fill: Washed gravel or crushed stone.
3. Common Fill: Mineral soil free from unsuitable materials.
4. Structural Fill: Clean, well graded gravel.
5. Suitable Soil: Cohesive soils in the soil classification groups ML, CL, CH or a combination, thereof, free of rock or gravel larger than 1" in any dimension, debris, waste, frozen material, vegetation and other deleterious material.
6. Embedment Material: 3/4" minus waste rock with fines or Suitable Soil

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All activities will be contained within construction boundaries indicated on site plan. Specified excavation requirements, precautions, and protective systems will be observed at all times.
- B. Movement of trucks and equipment on Owner's property will be in accordance with Owner's instructions.
- C. Topsoil will be stripped from the construction site and stockpiled in designated area. Excess topsoil will be stripped and disposed of legally off site.
- D. Trenches will not be backfilled until all required tests are completed and the utility systems, as installed, conform to requirements specified by the contract documents.
- E. Excavation is unclassified and includes excavation to subgrade regardless of materials encountered. Repair excavations beyond elevations and dimensions indicated as follows:
 1. At Structure: Concrete or compacted structural fill.
 2. Elsewhere: Backfill and compact as directed.
- F. Maintain stability of excavations; coordinate shoring and bracing as required by authorities having jurisdiction. Prevent surface and subsurface water from accumulating in excavations. Stockpile satisfactory materials for reuse, allow for proper drainage and do not stockpile materials within drip line of trees to remain.
- G. Compact materials at the optimum moisture content as determined by ASTM D 698 by aeration or wetting to the following percentages of maximum dry density:
 1. Structure, Pavement, Walkways: Subgrade and each fill layer to 95% (-2%+4%) of Standard Proctor maximum dry density to suitable depth. Compaction testing shall be performed immediately prior to the placement of reinforcing steel and new paving materials. Contractor shall be responsible for scheduling testing with owners designated testing agency.
 2. Unpaved Areas: Each fill layer to be 85% maximum dry density.
 3. A proof-roll shall be required of the subgrade prior to placement of the base course. Proof rolling shall consist of passing a loaded, 20-ton, tandem dump truck over the prepared subgrade soil with a maximum allowable displacement of 1". Any areas that displace more than 1" shall be

compacted until this criterion is met, or those areas may be excavated and backfilled with compacted Type 1 aggregate used for base material. All proof rolling shall be performed in the presence of the Owner's representative.

4. **Cut areas under proposed asphalt or concrete pavements shall be cut and compacted. After grading to subgrade elevation, scarify the top six inches of the sub-base and compact as outlined above.**
 5. Landscaped areas to be left 6" or 24" below proposed finish grade. Fill within 36" of finish grade to be fill per "Suitable Soil in Landscaped areas" as defined by 2.1-B.
- H. Place acceptable materials in layers not more than 6" loose depth for materials compacted by heavy equipment and not more than 4" loose depth for materials compacted by hand equipment to subgrades indicated as follows:
1. Structural Fill: Use under foundations, slabs on grade in layers as indicated.
 2. Drainage Fill: Use under designated building slabs, at foundation drainage and elsewhere as indicated.
 3. Common Fill: Use under unpaved areas.
 4. Subbase Material: Use under pavement, walks, steps, piping and conduit.
 5. Fill in landscape areas (excluding topsoil): Use suitable soil within 36" of finished grade in lawn and planter areas.
 6. Embedment Material: Use above new steam chase/tunnel utilities as indicated.
- I. Grade to within 1/2" above or below required subgrade and within a tolerance of 1/2" in 10'.
- J. Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed and damaged areas as necessary to restore quality, appearance, and condition of work.
- K. Control erosion to prevent runoff into sewers or damage to sloped or surfaced areas.
- L. Control dust to prevent hazards to adjacent properties and vehicles. Immediately repair or remedy damage caused by dust including air filters in equipment and vehicles. Clean soiled surfaces.
- M. Disposal of excavation waste and unsuitable materials shall be the responsibility of the site work contractor. No specific or pre-approved location is being provided by the owner.

END OF SECTION 312000

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SECTION 312500 – 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

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. Silt Fence: A geotextile barrier fence to contain sediment by removing suspended particles from water passing through the fence.
- D. 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

EROSION CONTROL

312500 - 1

A. 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

Property	Test Method	Wire Fence Supported Requirements	Self Supported Requirements
Tensile Strength, Lbs.	ASTM D4632	90 Minimum	90 Minimum
Elongation at 50% Minimum			
Tensile Strength (45 Lbs.)	ASTM D4632	N/A	50 Maximum
Filtering Efficiency, %	VTM-51	75	75
Flow Rate gal/ft/min	VTM-51	0.3	0.3
Ultraviolet Degradation at 500 hrs.	ASTM D4355	Minimum 70% Strength Retained	Minimum 70% Strength Retained

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.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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 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 SILT FENCE

- A. 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.
- B. 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.
- C. Installation
 - 1. Geotextile at the bottom of the fence shall be buried as indicated on the detail.
 - 2. The trench shall backfilled and the soil compacted over the geotextile. The geotextile shall be spliced together as indicated on the detail.
- D. 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.

E. 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.

3.6 SEDIMENT REMOVAL

A. General

1. Sediment deposits shall be removed when:
 - i. The deposits reach approximately one-half the height of a ditch check, straw bale barrier or silt fence.
 - ii. The sediments have reduced the ponded volume of sediment basins to one-third of the original volume.
 - iii. Requested by the Owner's Representative.

2. 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 312500

SECTION 32 1313 – CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

1. This section applies to all site concrete including but not limited to sidewalks, curb and gutters, and pavement .

1.2 SUBMITTALS

1. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
2. Design Mixes: Submit for approval design mixes, including adjustments for variations in project conditions.
 - a. Mixes to be designed in accordance with the Portland Cement Association.
 - b. All exposed concrete shall be air entrained. Allowable ranges shall be as follows:
 1. $\frac{3}{4}$ " to 1" aggregate size shall contain 6.0% average entrained air. The total air content range shall be between 5%-7%.
 - c. All concrete shall achieve 4000 psi compressive strength in 28 days.
 - d. Flint and chert to be limited to 1% maximum, by weight of the coarse aggregate, in all exposed concrete. Lignite will be limited to 0.5% by weight of both the coarse and fine aggregates in all exposed concrete.
 - e. Sand shall be from local sources meeting ASTM C-33 Size 67 for concrete.
 - f. The use of calcium chloride in concrete mixes will not be permitted.
 - g. Maximum water-to-cement ratio shall be 0.45
 - h. Portland cement replacement levels with fly ash should not exceed 15%.
 - i. Concrete slump shall be a maximum of 4" +/- 1" (ASTM C- 143) as delivered in the field. Contractor may use chemical admixtures to attain a maximum slump of 8" for workability. No water may be added to the concrete mix on site unless water is withheld at the batching facility. If water is withheld at the batching facility it should be reflected on the load ticket. The total amount of water in the mix shall not exceed what is noted on the approved mixed. This shall be noted in the special inspector's records.

3. Test Mix Reports: Submit test reports for approval prior to construction.

1.3 QUALITY ASSURANCE

1. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
2. Construction Tolerance: 1/8' in 10' for grade and alignment of top of forms; 1/4' in 10' for vertical face on longitudinal axis.
3. Testing: Independent testing agency shall be obtained by the Owner. Testing requirements shall be as follows:
 - a. An ACI certified Grade I field technician shall perform the testing
 - b. Test shall be performed for strength, air entrainment, temperature, and slump. Strength tests will require 4 cylinders (1 broken @ 7 days; 2 broken @ 28 days, 1 spare). Test results should be sent to the contractor, architect, and owner's representative.
 - c. Concrete will be tested at the minimum rate of one test for the first 25 cubic yards placed each day, and one test for each additional 50 cubic yards placed thereafter.
 - d. Test data from concrete cylinder breaks will be evaluated using procedures of ACI 214.

PART 2 - PRODUCTS

2.1 MATERIALS

1. Concrete Paving Materials:
 1. Accessories:
 - a. Wire Mesh Reinforcement: Welded plain steel wire fabric, ASTM A 185.
 - b. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60.
 - c. Fabricated Bar Mats: Steel bar or rod mats, ASTM A 184, using ASTM A 615, Grade 60 steel bars.
 - d. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60.
 - e. Hook Bolts: ASTM A 307, Grade A threaded bolts.
 - f. Liquid-Membrane Forming and Sealing Curing Compound: ASTM C 309, Type I, Class A.
 - g. Bonding Compound: Polyvinyl acetate or acrylic base.
 - h. Color Pigment: ASTM C 979.
 - i. Epoxy Adhesive: ASTM C 881.

PART 3 - EXECUTION

3.1 INSTALLATION

1. Comply with ACI 301 for measuring, mixing, transporting, and placing concrete.
2. Proof roll subbase and check for unstable areas. Report unsatisfactory conditions in writing to the owner's representative.
3. Comply with concrete section for concrete mix, testing placement, joints, tolerances, curing, repairs and protection.
4. All concrete trucks shall be directed to washout at plant.
5. Dispose of over-mixed concrete off-site in a legal manner.
6. Protect concrete paving until weight of a person will not leave any impression. Remove and replace concrete paving, which shows impressions or other defects. Skim coating defects is not acceptable.
7. Contraction joints shall be tooled during finishing or sawed within 18 hours of concrete placement. If the joint edge ravel, do not proceed until concrete has sufficient cure time to saw without damage.
 - a. Contraction joints shall have a minimum depth of $\frac{1}{4}$ of the pavement thickness and a minimum width of $\frac{1}{8}$ "
 - b. Transverse contraction joints will be provided at a maximum of 2.5 times the pavement thickness (in inches) in feet for street pavements and 2.0 times for all other pavements.
 - c. Longitudinal joints shall have a maximum separation of 14 feet for streets and drives and 9 feet for sidewalks.
 - d. The ratio of slab width to length should not exceed 1.67 for street pavements and 1.25 for all other pavements.
 - e. All joints to be sealed per Section 32 1373.

END OF SECTION 32 1313

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SECTION 32 1373 – CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
- B. Related Sections include the following:
 - 1. Division 32 Section “Concrete Paving” for constructing joints in concrete pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealed product indicated.
- B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer’s written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet or covered with frost.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone or Polyurethane Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
 - 1. Products:
 - a. Tremco Spectrum 900
 - b. BASF Sonolastic

2.4 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-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

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.
 - 1. 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backing are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved 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 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 with repaired areas are indistinguishable from the original work.

END OF SECTION 32 1373

SECTION 329219 - SEEDING

PART 1 GENERAL

1.1 SUMMARY

This section covers the operations necessary to produce established grass covered areas, including preparation of the soil surface, application of starter fertilizer, seeding, sodding, compacting and maintenance.

All areas with vegetation cover that are disturbed by construction operations, either by grading, parking of equipment, trenching, or any other operation that destroys the existing vegetative cover shall be seeded or sodded as specified herein.

Seeding: All disturbed existing vegetated areas shall be seeded, including grassy areas, and pasture lands.

Disturbed areas outside the authorized construction limits shall be seeded and mulched, or sodded at the Contractor's expense.

1.2 SUBMITTALS

A. The following submittals are required:

Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

Manufacturer's Certificate: Certify products meet or exceed specified requirements.

B. Soil Tests:

Not less than 6 weeks prior to seeding, obtain representative soil samples from areas to be seeded or sodded and have the soil tested for optimum soil amendment recommendations. Based on the test results, submit a recommendation as to the quantity and type of lime fertilizer, and seed for the area covered by the test.

PART 2 PRODUCTS

2.1 TOPSOIL

Topsoil shall consist of a fertile, friable soil of loamy character, free of sub-soil, clay, hard clods, stones, pebbles and other similar material. Topsoil shall be placed at a depth of six (6) inches. Topsoil shall contain a normal amount of natural humus and be reasonably free of roots, sand, noxious weed seeds, sticks, brush and other litter. The topsoil shall be obtained from well-drained, arable land, and be of an even texture so that all the soil will pass a ½ inch screen. The topsoil shall not be infested with nematodes or with any other noxious animal life or toxic

substances. Topsoil shall exhibit an acidity range (pH) of 6.0 to 8.5.

2.2 SEED

Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act and shall comply with the requirements of the Missouri Seed Law. The pure live grass seed mixture to be used in lawn and undeveloped areas shall be as follows:

Type	% of Mixture	Minimum	Minimum
	by Weight	Purity	Germination
Ultimate Tall Fescue	30%	99%	90%
Fine Lawn Elite Tall Fescue	30%	98%	90%
Falcon Four Tall Fescue	20%	99%	90%
Annual Rye	20%	99%	90%

The percent of mixture by weight is for pure live seed (PLS). Weed seed shall not exceed 1.0% by weight of the mixture. A certification of the mixture shall be furnished to the Engineer prior to seeding.

2.3 SOIL AMENDMENT

Fertilizer shall be a mixture containing 5.5 pounds of soluble nitrogen, 16 pounds of phosphorous and 16 pounds of potash per 100 pounds.

Agricultural lime material shall be used for soil neutralization with not less than 90% passing the No. 8 sieve.

2.4 MULCH

Mulch shall consist of the application of a vegetative covering of one of the following types:

1. Type I Mulch shall be the cereal straw from stalks of oats, rye, wheat or barley, which is clean, bright, and free of mold. The straw mulch shall be dry and relatively free of undesirable seed and foreign material.
2. Type II Mulch shall be as specified above for Type I mulch except that it shall also include the application of an overspray material consisting of virgin wood cellulose fibers or recycled slick paper as herein specified. The overspray shall be green in color after application and shall have the property to be evenly dispersed and suspended when agitated in water. When sprayed uniformly over vegetative mulch, the mulch fibers shall form an absorbent cover, allowing percolation of water to the underlying soil. The mulch shall be packaged in moisture resistant bags with the net weight of the packaged material plainly shown on each bag. The mulch fibers shall not be water soluble.

Virgin wood cellulose fibers shall be produced by either the ground or cooked fiber process and shall have the following properties:

Moisture Content, Percent by Weight (maximum)	15%
Organic Matter-Wood Fiber, Percent by Weight (minimum)	80%
Ph	4.3-8.5

Recycled slick paper mulch shall be produced from printers slick paper containing wood cellulose and kaolin clay. Recycled newsprint or cardboard will not be allowed. The material shall be free of other material or fillers and shall have the following properties:

Moisture Content, Percent by Weight (maximum)	8%
Ph	4.5-6.5

The Contractor shall furnish certification from the manufacturer that the overspray mulch material complies with these specifications.

3. Type III Mulch shall be material consisting of virgin wood cellulose fibers as herein specified. The mulch shall be green in color after application and shall have the property to be evenly dispersed and suspended when agitated in water. When sprayed uniformly over the soil surface, the mulch fibers shall form an absorbent cover, allowing percolation of water to the underlying soil. The mulch shall be packaged in moisture resistant bags with the net weight of the packaged material plainly shown on each bag.

Virgin wood cellulose fibers shall be produced by either the ground or cooked fiber process and shall have the following properties:

Moisture Content, Percent by Weight (maximum)	15%
Organic Matter-Wood Fiber, Percent by Weight (minimum)	80%
Ph	4.3-8.5

The Contractor shall furnish certification from the manufacturer that the mulch material complies with these specifications.

PART 3 EXECUTION

3.1 TIMING

Seeding shall not be placed from October 16 to December 31. Full seeding shall only be placed from January 1 to May 15 and from August 15 to October 15. Seeding shall not be placed on frozen or snow covered ground. Partial seeding shall be placed from May 16 to August 14. Type II mulch shall be used with partial seeding. The application rates for partial seeding are as shown below:

Lime 100% of the specified quantity Fertilizer 75% of the specified quantity Seed 50% of the specified quantity.

When partial seeding is placed, the remainder of the fertilizer plus 75% of the specified quantity of seed shall be applied by hydraulic overseeding from August 16 thru October 15. Hydraulic overseeding shall be applied over the existing Type II mulch. Seed and fertilizer, separately or in

combination, shall be mixed with water, and constantly agitated so that a uniform mixture can be applied hydraulically to the specified areas. The ratio of seed and fertilizer to water shall be calculated to achieve the specified coverage rates using a total of 500 gallons of water per acre applied in 2 applications. Seed shall not be added to the water more than 4 hours before application.

3.2 SEEDBED PREPARATION

For Type I or Type II Mulch: Seedbed preparation in lawn areas shall be accomplished by grading the disturbed areas and adding at least 4 inches of topsoil. The surface on which the topsoil is to be placed shall be free of all loose rock and foreign material greater in any dimension than 1/2 the depth of the topsoil to be added and the surface shall be loosened with a disc harrow just prior to being covered with topsoil. Topsoil shall be placed and spread to a depth sufficiently greater than specified so that after settling, the completed work will conform with the elevations shown on the plans. After spreading, all large clods and foreign material shall be removed by the Contractor.

Seedbed preparation in undeveloped areas shall be accomplished by tilling to a depth of 4 inches with a disc harrow, followed by smoothing with a weighted spike tooth harrow. After smoothing, all rocks and clods greater in any dimension than 2 inches, and all foreign material shall be removed by the Contractor. Designation of areas as lawn or undeveloped will be determined by the condition of the area at the start of construction.

Before final raking, areas to be seeded shall be limed at the rate of 92 pounds per 1,000 square feet of area and fertilized with the specified mixture by spreading evenly at the rate of 7 pounds per 1,000 square feet of area. Both operations shall be performed by using a mechanical spreader of the rotary type. The area shall then be raked to a smooth, even surface and the soil loosened to a depth of one inch in preparation for the seed. No seed or mulch shall be placed until the Engineer accepts the grade and seedbed. Seeding shall be accomplished by using a mechanical spreader. The seed mixture shall be evenly distributed over the area at the rate of 5 pounds per 1,000 square feet. Immediately after the seeding is completed, all seeded areas shall be mulched as described below for that type of mulch specified.

1. Type I Mulch must be applied in an even layer approximately ¼ inch in depth. Immediately after placement of the mulch, the entire mulched area shall be thoroughly saturated with water.
2. Type II Mulch shall be applied same as for Type I Mulch with the addition of an overspray. The overspray shall be hydraulically applied as a separate operation at the rate of 750 pounds per acre. The overspray material shall be mixed with water in a manner to provide a homogeneous slurry. Equipment for mixing and applying the slurry shall be capable of applying it uniformly over the entire vegetative mulched area. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed.

For Type III Mulch: Seedbed preparation shall be accomplished in the same manner as for Type I and II mulch up to the point of seeding. The seed and Type III mulch will be mixed and applied hydraulically with equipment approved by the Engineer. The hydraulic application shall be such

that the seed mixture is distributed at the rate of 5 pounds per 1,000 square feet and the Type III mulch is distributed at the rate of 46 pounds per 1,000 square feet. The seed mixture and Type III mulch shall be mixed with water in a manner to provide a homogeneous slurry. Equipment for mixing and applying the slurry shall be capable of applying a uniform mixture over the entire area to be mulched. The slurry mixture shall be agitated during application to keep the ingredients thoroughly mixed.

3.3 MAINTENANCE REQUIREMENTS

Since the seeded area shall be maintained by the Contractor as necessary to assure growth. A guarantee period not less than the correction period from the Final Acceptance of the work will be required. During the guarantee period, if there are deficient areas where the grass died, or where sheet and rill erosion or settlement occurred, or where gravel or other deleterious backfill material surfaces, upon notification by the Owner or Owner's Representative of such areas, the Contractor shall re-work all areas as necessary to bring the areas into conformance with the specifications.

END OF SECTION 329219

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