

PROJECT MANUAL FOR:
JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

PROJECT NUMBER:
CP242812

AT:
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

FOR:
THE CURATORS OF
THE UNIVERSITY OF MISSOURI

PREPARED BY:
INTERNATIONAL ARCHITECTS ATELIER
912 BROADWAY BLVD, SUITE 300
KANSAS CITY, MISSOURI 64105
816-471-6522

DATE:
FEBRUARY 7, 2025

ISSUE FOR BID



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ARCHITECTURAL

The Architects seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the Architect takes responsibility for the attached architectural specifications. The Architect hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

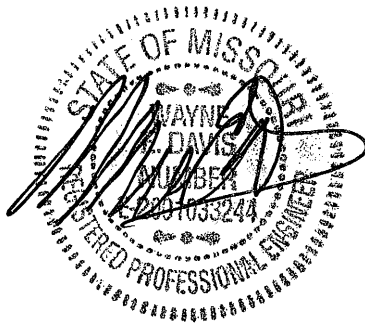
Specification Section 020810 and the Hazardous Building Material Survey are technical documents that have been prepared by a qualified third party hazardous materials testing lab. The specification was not prepared under the direct supervision of the architect and therefore is not included as part of the architect's certification.



Signature: _____ 2-7-2025

STRUCTURAL

The Structural Engineers seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the Engineer takes responsibility for the attached structural specifications. The Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

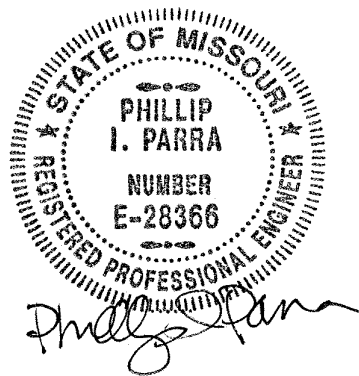


2-7-25

Signature: _____

MECHANICAL, ELECTRICAL AND FIRE PROTECTION

The Mechanical, Electrical, and Fire Protection Engineers seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the Engineer takes responsibility for the attached mechanical, electrical and fire protection specifications. The Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.



February 7, 2025

Signature: _____

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END OF SECTION

PLANNING DESIGN & CONSTRUCTION

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

ADVERTISEMENT FOR BIDS

Sealed bids for:

JESSE HALL AUDITORIUM –
BUILDING ENVELOPE UPDATE
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

PROJECT NUMBER: CP242812

CONSTRUCTION ESTIMATE: \$5,000,000 - \$5,500,000

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., February 26, 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 Majid Amirahmadi with International Architects Atelier at (816) 471-6522 or majid@i-a-a.com. Questions regarding commercial conditions should be directed to Heather Brown at (573) 884-6322 or brownheat@missouri.edu.

A prebid meeting will be held at 10:00 a.m., C.T., February 18, 2025 in the General Services Bldg., Room 194B, followed by a site walk-through.

A Diversity Participation goal of 10% MBE, 10% WBE, DBE and Veteran; 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: February 7, 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 Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri
Columbia, Missouri 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by INTERNATIONAL ARCHITECTS ATELIER, entitled "JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE" project number CP242812, dated February 7, 2025 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 to restore masonry at the north, east, and south elevations of Jesse Auditorium. Replace all flat membrane roof portions and smoke vents of Jesse Auditorium; all as indicated on the Drawings and described in these Specifications for a sum of: _____ DOLLARS (\$ _____).

b. Additive Alternate Bids:

Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1:

Furnish all labor, materials, tools, and equipment required to relocate existing stage radiant heaters along the east interior wall face of the stage and attach to new framing attached to existing pilasters. Re: Sheets D110, A110, M102 and ME202:

_____ DOLLARS (\$ _____)

(2) Additive Alternate No. 2:

Furnish all labor, materials, tools, and equipment required to install new lightning protection system at the Auditorium Roof. Re: Sheets E203 and E400.:

_____ DOLLARS (\$ _____)

(3) Additive Alternate No. 3:

Base Bid scope shall be to disconnect and temporarily remove existing air handling unit on top of stage roof in order to replace the existing roof and unit curb. Alternate scope of work is to furnish all labor, materials, tools, and equipment required to refurbish components of existing air handling unit before reinstalling on new roof curb. Re: Mechanical Sheets:

_____ DOLLARS (\$ _____)

- (4) Additive Alternate No. 4:
Furnish all labor, materials, tools, and equipment required to install 5/8" substrate board on top of existing cast-in-place concrete roof deck at Roofs B & C as shown on roof detail sheets on drawings. All for sum of:

_____ DOLLARS (\$ _____)

c. 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.

FILL IN ONLY ONE PRICE PER LINE

- (6) Crack Injection: All fractures or cracks that are less than or equal to 1/8" shall be injected with dispersed hydrated lime (DHL). If a cavity is too deep to be filled using DHL, an application of NHL shall be used to top over the opening. DHL shall be custom matched to limestone. Refer to Masonry Restoration Keynote 13.

Base Bid quantity = 40 l.f. \$ /l.f.

- (7) Stone Patch: Prepare spalling stone per Drawings. Patch with historic

patching material to match existing stone and profile.

Base Bid quantity = 10 ea. \$ ea.

- (8) Micro-Pin Repair: Use micro pins for locations of detached stone where the thickness of the spall is less than or equal to 2". Use 4 mm stainless steel or titanium surgical bone screws inserted by hand using a hex key. All pins shall have a minimum embedment depth of 2" into the parent stone. Screw heads shall have a 1/4" countersunk depth. Pins shall be spaced a minimum distance of 6" apart. Provide a minimum distance of 3" from the edge of the stone unit.

Base Bid quantity = 5 ea. \$ ea.

- (9) Threaded Rod Repair: For locations of delaminated stone where the thickness of the spall is greater than 2", 3/8" all threaded rod shall be used. Anchor threaded rods into pilot holes using masonry adhesive grout. All pins shall have a minimum embedment depth of 2" into the parent stone. Threaded rods shall have a 1/4" countersunk depth. Pins shall be spaced a minimum distance of 6" apart. Provide a minimum distance of 3" from the edge of the stone unit.

Base Bid quantity = 75 ea. \$ ea.

- (10) Dutchman: Cut and prepare stone to receive Dutchman repair.

Base Bid quantity = 0 ea. \$ ea.

- (11) Reset Displaced Stone: Rake mortar joints around the displaced stone. Reset stone to its original location and tuck point mortar joint around the stone.

Base Bid quantity = 10 ea. \$ ea.

- (12) Stone Spall at Rusted Anchor: Prepare damaged stone at rusted anchor per Drawings.

Base Bid quantity = 5 ea. \$ ea.

- (14.) Miscellaneous sealant joint and backer rod installation beyond amounts shown on drawings.

Base Bid Quantity = as shown in drawings \$ / lf.

- (15.) Damaged brick removal and replacement, at locations to be determined by Architect.

Base Bid Quantity = as shown in drawing elevations
\$ / sf.

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 two hundred and twenty one (221) 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 – Refer to Special Scheduling SC-1

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

MASONRY RESTORATION _____

Masonry sub-contractors have been pre-qualified for this project; to submit a responsive bid one of the following contractors must be listed as a sub-contractor: Bulley & Andrews Masonry Restoration (BAMR), Pullman, MTS Contracting Inc.

ROOFING _____

PLUMBING _____

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.	Federal Employer ID 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**

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

1. Company Name _____

Phone# _____ Fax #: _____

Address _____

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

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

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

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

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

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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6. Other experience qualifying you for the work now bid.

7. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made _____

(b) Description of defaulted contracts and reason therefor

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?

Yes _____ No _____

(b) Have you filed all required compliance reports?

Yes _____ No _____

- (c) Is fifty percent or more of your company owned by a minority?
Yes _____ No _____
- (d) Is fifty percent or more of your company owned by a woman?
Yes _____ No _____
- (e) Is fifty percent or more of your company owned by a service disabled veteran?
Yes _____ No _____
- (f) Is fifty percent or more of your company owned by a veteran?
Yes _____ No _____
- (g) Is your company a Disadvantaged Business Enterprise?
Yes _____ No _____

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

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

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

12. List banking references.

- 13. (a) Do you have a current confidential financial statement on file with Owner?
Yes _____ No _____ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?
Yes _____ No _____

Dated at _____ this _____ day of _____ 20_____

Name of Organization

Signature

Printed Name

Title of Person Signing

END OF SECTION

SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM

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

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

I. Project: _____

II. Name of General Contractor: _____

III. Name of Diverse Firm: _____
Address: _____

Phone No.: _____ Fax No.: _____

Status (check one) MBE _____ WBE _____ Veteran _____ Service Disabled Veteran _____ DBE _____

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

Base Bid: _____

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

Base Bid: _____

Alternate(s), (Identify separately): _____

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

Yes _____ No _____

Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes _____

No _____

If yes, please provide details and attach a copy of the certification.

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

Yes _____

No _____

If yes, please attach letter.

Signature:

Name:

Title:

Date:

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/slcdc/

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

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

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

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

July 2024 Edition

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**ARTICLE 1
GENERAL PROVISIONS**

1.1 Basic Definitions

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

1.1.1 Owner

The 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 existing 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 Contractors 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 not withstanding 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, lightning, 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. 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 February 7, 2025, entitled "JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE", project number CP242812.
- b. Architect
International Architects Atelier
912 Broadway Blvd, Suite 300
Kansas City, MO 64105
P: 816-471-6522
- c. Structural Engineer
Bob D. Campbell & Co.
4338 Belleview Ave.
Kansas City, MO 64111
P: 816-531-4144
- d. Mechanical, Electrical and Fire Protection Consultant
IMEG Corp.
1600 Baltimore
Kansas City, MO 64108
P: 816-842-8437

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 7:00 a.m. to 5:00 p.m., Monday through Friday. Access and work efforts outside of these normal working hours to be coordinated with the Owner's representative.

Mobilization on site cannot begin until March 6, 2025. Contractor permitted to begin work and/or erect scaffolding along the east and south elevations of Jess Auditorium before Commencement Weekend, May 16, 2025.

Contractor shall not start work or erect scaffolding along the north elevation of Jesse Auditorium until after Commencement Weekend, May 19, 2025.

Masonry contractor shall be complete, including all punch list items, and have scaffolding removed by Homecoming September 27, 2025.

Tuesday, March 11, 2025, an event at the project site will require quiet time from 7:00 am to 11:00 am.

Thursday, March 13 through Wednesday, March 19, 2025, work can continue on site as long as the parking areas and loading dock door is safe with required protection and accessible after 4 pm each day.

Wednesday, March 26, 2025, there is an event all day long in which work cannot be done on site.

Tuesday, April 1, 2025, the project parking areas and loading dock will be needed for Owner's use all day for major touring show performances that evening.

Friday, April 4, 2025, the project parking areas and loading dock will be needed for Owner's use all day for major touring show performances that evening.

Thursday, April 10, 2025, the Owner will have an evening event after regular work hours. **No construction impact is anticipated.**

Saturday, April 12, 2025, the Owner will have an evening event after regular work hours. **No construction impact is anticipated.**

Monday, April 14 through Thursday, April 17, 2025, the Owner will be having evening events after regular work hours. **No construction impact is anticipated.**

Friday, April 18, 2025, there is an Owner event for the entire day. No construction activities shall take place during this date.

Friday, April 25, 2025, there is an Owner event starting at 3:00 pm. All construction activities shall stop on site by 2:00 pm.

Saturday, April 26 through Sunday, April 27, 2025, there is an Owner event all weekend outside of regular work hours. **No construction impact is anticipated.**

Friday, May 2, 2025, the Owner will have an evening event after regular work hours. **No construction impact is anticipated.**

Friday, May 16 through Sunday, May 18, 2025 Spring Commence Ceremonies will be held. No construction activities shall take place during these dates.

Jesse Auditorium will not be in use by the Owner after Commencement, May 19, 2025.

Jesse Auditorium will be opened and used by the Owner starting by October 1, 2025.

Wednesday, October 1, 2025, is the Owner's State of the University Address on site. No construction activities shall take place during this date.

Saturday, October 4, 2025, the Owner will have a morning event outside of regular working hours. **No construction impact is anticipated.**

Thursday, October 9 through Sunday, October 12, 2025, the Owner will be performing Homecoming skit rehearsals in the evening after regular working hours. **No construction impact is anticipated.**

Monday, October 13 through Wednesday, October 15, 2025, the Owner will be performing Homecoming skit rehearsals in the evening after regular working hours. **No construction impact is anticipated.**

Thursday, October 16 through Friday, October 17, 2025, the Owner will be having Step Show evening events after regular working hours. **No construction impact is anticipated.**

Saturday, October 25, 2025, the Owner will be hosting India Nite event in the evening after regular working hours. **No construction impact is anticipated.**

Contractor shall submit to Architect all required product data, shop drawings, and other submittals for the automatic smoke vents within 30 days of Contractor receiving unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates."

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 building masonry envelope restoration and roof replacement at Jesse Auditorium.
- (2) Demolition shall consist of removal of the existing single ply membrane roofing assembly and existing metal framed smoke vents.
- (3) Architectural work shall consist of new EPDM roofing assembly and masonry restoration at Jesse Auditorium.
- (4) Structural work shall consist of new framing for infills of the roof slab, framing for new smoke vents, and framing for new roof access.
- (5) Mechanical work shall consist of refurbishment requirements of existing air handling unit and relocation of existing stage radiant heaters.
- (6) Electrical work shall consist of new lightning protection systems around Jesse Auditorium and fire protection electrical connections to the new smoke vents.
- (7) Plumbing work shall consist of new roof drain bodies and new emergency overflow drains and associated piping to exterior wall outlets.

4. LOCATION

- a. Work shall be performed under this Contract on the campus of the University of Missouri – Columbia, at Jesse Auditorium.

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:
 - (1) The Owner will issue Contractor service vehicle parking permits for use in University Parking lot RC3. The permits will be issued at no cost to the contractor up to the contract completion date. After the contract completion date, the permits will be re-issued on an as available basis at the contractor's expense. These permits are to be used for general contractor or subcontractor owned and labeled vehicles only. Personal vehicles are prohibited from use of these permits. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
 - (2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
 - (3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
 - (4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. 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.
 - (5) Free parking for contractor employees is available in the Ashland

Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.

- (6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.
 - (7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.
 - (8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.
- c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.
 - 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. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.
- i. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- j. 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. For landscape damage, the Owners shall make such 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) Fence screening fabric shall be used on all perimeter fencing. Fabric shall be black in color, full height of the project fence, securely attached and properly maintained throughout the duration of the project. Coordinate with Owner’s representative to confirm if Owner has any screening fabric that they would like to use on site in lieu of the black fabric.
 - (3) 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.

- (4) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (5) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (6) 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) 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) Removal and/or pruning of select landscape materials shall be performed by MU Landscape Services department.

9. SUBSTITUTIONS AND EQUALS

- a. Substitutions are defined in general conditions Article 3 point 11.84 and equals are defined in general conditions article 3.12.
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals 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.
- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.
- d. No substitutions and/or equal will be allowed for the following items:

<u>Item</u>	<u>Specification Section</u>
Historic Pointing Mortar	045000
Historic Stone Patching	045000
Dispersed Hydrated Lime	045000
Injection	045000

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.
- b. Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 30-2.065. Their permit applications are available at <https://dfs.dps.mo.gov/programs/bpv/>.

13. SPECIALTIES

- a. Owner furnished topsoil: The Owner will place the topsoil and provide final grade. The contractor shall rough grade to the following specifications:
 - (1) The sub-grade is to be left at minus six inches (6") in all areas unless indicated otherwise. All planting bed sub-grades are to be left a minus eighteen inches (18"). The contractor is to remove all deleterious material from the sub-grade prior to placing topsoil. All subgrade areas shall contain at least 6" of subsoil, (ie. cover clean rock backfilled areas). All subgrade areas shall be "ripped" a minimum of 6" deep and a maximum of 12" apart in opposite directions with minimal tire traffic to follow. All exposed deleterious material and unacceptable rock shall be removed.
 - (2) The contractor shall adjust all yard boxes valve boxes, pull boxes, cleanouts, and manhole lid rings etc. (includes irrigation, sewers, water and electric), to the indicated finish grade.
 - (3) Final plantings will be by the Owner. The Owner will water and maintain all seed, sod and landscaping.

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. ROOF CERTIFICATION AND WARRANTY REQUIREMENT

- a. The Contractor shall submit a copy of the University of Missouri Roof System Manufacturer's Certification for each proposed roofing system, within two business days following receipt of bids by the Owner. The Certification shall be submitted to the Owner and the Architect of Record and shall be manually signed by an authorized representative of Manufacturer of each proposed roofing system. Certification shall have original signature.

- b. The Contractor shall submit a sample copy of the Roof Manufacturer's Warranty for each proposed roofing system, within two (2) business days following receipt of bids by the Owner, clearly labeled as "SAMPLE". The sample warranty(s) shall be submitted to the Owner and the Architect of Record.
- c. The Owner and Architect of Record will review both documents for compliance with the Contract Documents and will notify the Contractor with required modifications.
- d. Within two weeks following final inspection and acceptance of the roofing system(s) by the Owner and the roofing system manufacturer(s), the Contractor shall submit a manually signed standard warranty agreement, in the same form as the sample, provided and executed by the roofing system manufacturer for each roofing system provided. Standard warranty agreement(s) shall be of the duration specified in Division 7.
- e. University of Missouri three (3) year Contractor's Roofing/Flashing/Sheetmetal Guarantee shall be signed by the roofing contractor after final inspection and acceptance of each roofing system by Manufacturer and by Owner.

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. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF QUALIFICATIONS

- a. Information For Bidders
 - (1) Reference: Information for Bidders, Article 8.4. Add new Article 8.4 to read as follows:

Masonry Restoration sub-contractors must be pre-qualified to carry out their respective, pertinent scopes of work, per the requirements

set forth in specification section 045000 – Exterior Historic Masonry Restoration. Only pre-qualified Masonry Restoration sub-contractors shall perform the masonry restoration work for this project.

17. MODIFICATIONS TO GENERAL CONDITIONS

- (1) Reference: General Conditions Article 11.2.1 Commercial General Liability.
 - (a) DELETE in the first sentence of 11.2.1: \$2,000,000 per occurrence, \$5,000,000 in general aggregate, \$5,000,000 products and completed operations aggregate and \$1,000,000 personal injury and advertising injury.” INSERT “\$2,000,000 per occurrence, \$10,000,000 in general aggregate, \$10,000,000 products and completed operations aggregate and \$1,000,000 personal injury and advertising injury.”
- (2) 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.

18. 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 fragments 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 path method (CPM) of scheduling and reporting progress of the Work.
- (b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.

- (c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
- (d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
- (e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
- (f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.
- (g) Critical activities are activities on the critical path.
- (h) Predecessor activity is an activity that must be completed before a given activity can be started.
- (i) Milestone: A key or critical point in time for reference or measurement.
- (j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor but is a project resource available to both parties as needed to meet contract milestones and the completion date.
- (k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
- (l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.(d)(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 purposed 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 Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact,

along with actually required predecessors and successors.

(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.

19. PROJECT COORDINATION (NOT USED)
20. PROJECT PARTNERING (NOT USED)
21. VALUE ENGINEERING (NOT USED)
22. BUILDING SYSTEM COMMISSIONING (NOT USED)
23. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION MEETING(S) (NOT USED)
24. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES / SPEND DOWN PURPOSES (NOT USED)

25. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

- a. The Contractor shall be represented at the site by both a competent full-time Project Manager and a full-time, 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.

26. SAFETY PRECAUTIONS AND PROGRAMS (NOT USED)

27. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

- a. Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and NFPA 51B.
 - (1) Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
 - (2) The Contractor shall utilize the hot work permit decision tree and permit provided in the NFPA 51B for all Hot Work operations.
 - (3) A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
 - (4) Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system

outage with Campus Maintenance personnel.

- (5) Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.
- (6) Special hot work requirements: Use thermal imaging cameras after hot work operations- describe criteria in detail (for historically significant buildings of wood construction); designate additional fire watch monitoring beyond the NFPA 30-minute post hot work requirement (project has a greater potential for reflash or smoldering fire due to concealed combustible building elements, etc.).

28. 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) Submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for all lifts to be used on the project. Include protective measures for existing underground utilities, steam tunnels, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. Provide plan for flaggers and signal persons to be in place to direct pedestrian and vehicular traffic while crane is in operation. 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.

29. CONSTRUCTION WASTE MANAGEMENT (NOT USED)

30. 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.1

UNIVERSITY OF MISSOURI
ROOF SYSTEM MANUFACTURER CERTIFICATION
(Revised 06/24)

TO: _____

Title: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project No. CP242812

Location _____

Our technical staff has examined the Architect/Engineer's Drawings, Specifications and required warranty for the roofing work on this project. We do not wholly endorse the building design or any materials or services not part of our advertised roofing system.

CERTIFICATION

We hereby certify that:

1. All materials we will furnish and deliver to the project shall be of good merchantable quality, shall meet or exceed the Specifications required and shall, if properly applied by one of our approved roofing applicator firms in accord with our instructions, provide a sound weather/watertight roofing system.
2. Upon completion of the installation in accord with the Drawings and specifications and our recommended installation procedures, we shall issue a total system warranty specified in the project Specifications.
3. The Drawings and Specifications follow the recommendations of our roofing manual for this type of roofing system with:

No exceptions.

The following exceptions: (The roofing system will be approved for this project if the following changes are made to the Contract Documents. The bid provided with this Document includes the required changes).

NOTE: Exceptions may cause Owner to reject bid.
Exceptions are as follows:

4. The Warranty will be issued for the following proposed roofing system:

ROOFING SYSTEM MANUFACTURER: _____

Authorized Signature: _____

Title: _____ Date _____

Telephone Number: () _____

Fax Number: () _____

SECTION 1.E.2

UNIVERSITY OF MISSOURI
CONTRACTOR'S ROOFING/FLASHING/SHEET METAL GUARANTEE
(Revised 06/24)

WHEREAS (NAME AND ADDRESS OF COMPANY) _____

herein referred to as Roofing Contractor, certify that they have furnished and installed all roofing, flashing, sheet metal and related components in accordance with the Contract Documents and as required by the Roofing System Manufacturer=s installation instructions on the facility described below:

Facility: _____

Owner: University of Missouri-(CAMPUS)
(CAMPUS ADDRESS)

Date of Full Completion: _____

Approximate Area of Roof: _____

Type of Roofing Material: _____

Manufacturer's Specification Number: _____

Thickness and Type of Roof Insulation: _____

NOW, THEREFORE, Roofing Contractor guaranties to the Owner, subject only to the exclusions stated hereinafter, that all roofing, flashing and sheetmetal work is fully and integrally watertight and is free from faults and defects in material or workmanship, and is guaranteed for a period of three (3) years from date of full completion of work.

EXCLUSIONS: This guarantee does not cover, and Roofing Contractor shall not be liable for the following:

1. Damage to the roofing system caused by fire, lightning, tornado, hurricane or hailstorm.
2. Damage to roofing system caused by significant settlement, distortion or failure of roof deck, walls, or foundations of building, excepting normal building expansion and contraction is not a part of this exclusion.
3. Abuse by the Owner and/or third parties.

REPAIRS: Owner shall promptly notify Roofing Contractor, in writing, of the need for repair of roofing, flashing, or sheet metal:

1. Roofing Contractor, within eight (8) hours after receipt of such notice, shall make emergency repairs at its expense, as required to render the facility watertight.
2. Within five (5) days after receipt of such notice, Roofing Contractor shall at its expense correct any faults or defects in material or workmanship.
3. Should needed repairs not be covered by this guarantee, Roofing Contractor, after having obtained Owner's written consent, shall make such repairs at Owner's expense. Following said repairs, this guarantee shall thereafter remain in effect for the unexpired portion of the original term. If Owner

does not so consent or repairs are made by others than the Roofing Contractor, this guarantee shall terminate for those parts of the roof affected by the repair.

4. In the event that Owner has notified the Roofing Contractor of the need for repairs and (i) Roofing Contractor does not immediately make repairs, or (ii) Roofing Contractor disclaims responsibility for the repairs and Owner disagrees, or (iii) Owner considers Roofing Contractor=s quoted cost for repairs not covered by this guarantee to be unreasonable and, an emergency condition exists which requires prompt repair to avoid substantial damage or loss to Owner, then, Owner may make such temporary repairs as he finds necessary and such action shall not be a breach of the provisions of this guarantee.

ANNUAL INSPECTIONS: Roofing Contractor shall inspect roof installation prior to each of the three anniversary dates from date of full completion of the work.

1. Inspection team to include Roofing Contractor, Roof Manufacturer, and Owner=s Representative.
2. Inspection of total roof system will be included in the annual inspections.
3. All defects in total roof system will be corrected by the Roofing Contractor within 30 days of inspection.
4. Roof manufacturer will certify by a written report that roof inspection has been completed, defects are acknowledged, and will warrant any repairs.
5. All corrective work completed by Roofing Contractor shall be warranted as approved by the Roofing Manufacturer.

ROOF MODIFICATION: Should Owner require work to be done on roof of said facility including modifications, alternations, extensions or additions to roof and including installation of vents, platforms, equipment, bracings or fastenings, Owner shall notify Roofing Contractor and give Roofing Contractor an opportunity to make recommendations as to methods necessary to safeguard against damage to roofing covered by this guarantee. Failure of Owner to give Roofing Contractor such opportunity or failure to follow methods recommended by Roofing Contractor shall render this guarantee null and void to the extent such failure should result in damage to roofing covered by this guarantee.

NOTICES: Notification of Roofing Contractor by Owner, shall be fulfilled by sending notice to Roofing Contractor.

IN WITNESS WHEREOF, we set our hands this _____ day of _____, 20____.

By: _____

Title: _____

For Roofing Contractor

Name: _____

Address: _____

Phone: _____

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

Contractor:

Section	Description	Contractor	Date Received	Date Returned	Comments
024119	Selective Demolition				
	Proposed Protection Measures				
	Schedule of Selective Demolition Activities				
	Predemolition Photographs or Video				
045000	Exterior Historic Masonry Restoration				
	Resume of Persons Supervising & Performing Work				
	Visual Performance for Technicians Proposed for Raking & Cutting Joints				
	Documentation of Existing Conditions				
	Product Data				
	Quality Control Program				
	Masonry Historic Treatment Program				
	Samples for Initial Selection				
	Shop Drawings				
	Field Construction Mock-ups				
	Preconstruction Photographs				
	Written Certificates from Historic Pointing Mortar Manufacturer				
	Samples of All Specified Materials				
	Certificates for Compliance of Specifications				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

Contractor:

Section	Description	Contractor	Discipline Responsible	Date Received	Date Returned	Comments
045000	Written Verification that Specified Items will be Used					
	Preconstruction Testing Service					
051200	Structural Steel Framing					
	Product Data					
	Shop Drawings					
	Mill Test Reports					
	Source quality-control Reports					
	Fabricator Qualifications					
	Welding Compliance					
	Material Safety Data Sheets					
053100	Steel Decking					
	Product Data					
	Shop Drawings					
	Welding Certificates					
	Welding Qualifications					
	FM Approval's RoofNav Listing					
054000	Cold-Formed Metal Framing					
	Product Data					

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
055000	Metal Fabrications					
	Product Data					
	Shop Drawings					
	Research Reports					
	Welding Certificates					
061000	Rough Carpentry					
	Product Data					
	Evaluation Reports					
073126	Slate Shingles					
	Product Data					
	Samples					
	Material Test Reports					
	Evaluation Reports					
075323	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing					
	Product Data					
	Shop Drawings					
	Qualification Data					
	Manufacturer Certificates					

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

Contractor:

Section	Description	Contractor	Discipline Responsible	Date Received	Date Returned	Comments
075323	Product Test Reports					
	Evaluation Reports					
	Field quality-control Reports					
076200	Sheet Metal Flashing and Trim					
	Product Data					
	Shop Drawings					
	Samples for Verification					
	Qualification Data					
	Product Certificates					
	Product Test Reports					
	Evaluation Reports					
077200	Roof Accessories					
	Product Data					
	Shop Drawings					
	Coordination Drawings					
079200	Joint Sealants					
	Product Data					
	Samples for Initial Selection					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE
 Project Number: CP242812
 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>
079200	Joint-Sealant Schedule					
	Product Test Reports					
	Installer Qualifications					
	Product Testing					
	Mockups					
	Sample Warranties					
092900	Gypsum Board					
	Product Data					
099600	High-Performance Coatings					
	Product Data					
	Samples for Verification					
	Product List					
220500	Common Work Results for Plumbing					
	Product Data					
220529	Hangers & Supports for Plumbing Piping & Equipment					
	Product Data					
	Welding Certificates					
221413	Facility Storm Drainage Piping					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
221413	Product Data					
	Field quality-control Inspection & Test Reports					
221423	Storm Drainage Piping Specialties					
	Product Data					
230513	Motors					
	Shop Drawings					
230529	HVAC Supports and Anchors					
	Shop Drawings					
230553	HVAC Identification					
	Shop Drawings					
	Valve Chart & Schedule					
230594	Testing, Adjusting, and Balancing					
	Final Reports					
	Field Reports					
230713	Ductwork Insulation					
	Shop Drawings					
230719	HVAC Piping Insulation					
	Shop Drawings					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
230900	Controls					
	Shop Drawings					
	Product Data					
	Labeling Information					
	Written Description of Sequence of Operation					
	Wiring Diagrams					
	Field Routing of Proposed Network Bus Diagram					
	Diagrams of the Control System					
232100	Hydronic Piping					
	Product Data					
232116	Hydronic Specialties					
	Product Data					
	CAD Coordination Drawings					
232200	Steam and Steam Condensate Piping					
	Product Data					
	Certification of Compliance for Welders					
232218	Steam and Condensate Specialties					
	Product Data					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
232218	Schedule					
	Electrical Power/Controls Wiring Diagrams & Product Data					
	Manufacturer's Installation Instructions					
233100	Ductwork					
	Shop Drawings					
	Duct Fabrications Standards					
	Duct Leakage Test Summary Report					
	CAD Coordination Drawings					
237323	Roof Mounted Air Handling Unit Refurbishment					
	Shop Drawings					
	Construction Details					
238216	Air Coils					
	Shop Drawings					
	Manufacturer's Installation Instructions					
	Manufacturer's Data					
260500	Basic Electrical Requirements					
	Coordination Drawings					
260513	Wire and Cable					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
260513	Shop Drawings					
	Manufacturer's Installation Instructions					
260526	Grounding and Bonding					
	Shop Drawings					
	Product Data					
	Field Test Reports					
	Layout Drawings					
260533	Conduit and Boxes					
	Coordination Files					
260553	Electrical Identification					
	Product Data					
	Schedule of Nomenclature					
	Samples of Graphic Representation					
264100	Lightning Protection Systems					
	Manufacturer Qualifications					
	Installer Qualifications					
265119	LED Lighting					
	Product Data					

SHOP DRAWING AND SUBMITTAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
265119	LED Lighting Performance Testing Submittal					
	LED Lighting Control Compatibility Submittal					
	Design Lights Consortium Information					
	Utility Rebate Forms					
	Mockup					
280500	Basic Electronic Safety and Security System Requirements					
	Coordination Drawings					
283100	Fire Alarm and Detection Systems					
	Shop Drawings					
	Product Data					
	CAD Floor Plans					
	Manufacturer's Wiring Requirements					
	Manufacturer's Voltage Drop Requirements					
	Installation Manual					
	Manufacturer's Certificates					
	System Battery Information					
	Voice Alarm Communication System Information					
	Incident Commander Display Information					

SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
075323	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing							
	Maintenance Data							
076200	Sheet Metal Flashing and Trim							
	Maintenance Data							
077200	Roof Accessories							
	Operation & Maintenance Data							
230500	Basic HVAC Requirements							
	Operation & Maintenance Data							
230513	Motors							
	Operation & Maintenance Data							
232218	Steam and Steam Condensate Specialties							
	Operation & Maintenance Data							
283100	Fire Alarm and Detection Systems							
	Maintenance Manuals							

SECTION 1.E.5

CLOSEOUT LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

Contractor:

Section	Description	Contractor / Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
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.					
075323	Ethylene-Propylene-Diene-Monomer (EPDM) Roofing					
	Sample Warranties					
	Special Warranty					
	Special Project Warranty					
076200	Sheet Metal Flashing and Trim					
	Sample Warranty					
	Special Warranty					
	Special Warranty on Finishes					
077200	Roof Accessories					

CLOSEOUT LOG

Project: JESSE HALL AUDITORIUM - BUILDING ENVELOPE UPDATE

Project Number: CP242812

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>
077200	Sample Warranties					
	Special Warranty on Painted Finishes					
079200	Joint Sealants					
	Sample Warranties					
	Special Installer's Warranty					
	Special Manufacturer's Warranty					
099600	High-Performance Coatings					
	Furnish Extra Materials					
230500	Basic HVAC Requirements					
	Warranty					
	Record Documents					
230900	Controls					
	As-Built Diagram of Network Bus Routing					
237323	Roof Mounted Air Handling Unit Refurbishment					
	Parts & Labor Warranty					

SECTION 1.F

INDEX OF DRAWINGS

Drawings referred to in and accompanying this Project Manual consist of the following sheets dated February 7, 2025.

G000	COVER SHEET
G001	GENERAL INFORMATION
D100	DEMOLITION ROOF PLAN
D110	INTERIOR PARTIAL DEMO PLANS & ELEVATIONS
D200	AUDITORIUM NORTH ELEVATION
D201	AUDITORIUM EAST ELEVATION
D202	AUDITORIUM SOUTH ELEVATION
D203	PENTHOUSE & PARAPET ELEVATIONS
D500	AUDITORIUM DEMOLITION DETAILS
D501	AUDITORIUM DEMOLITION DETAILS
D800	DEMOLITION PHOTOGRAPHS
A100	ROOF PLAN
A110	INTERIOR PARTIAL PLANS & ELEVATIONS
A111	INTERIOR PARTIAL PLANS – OVERFLOW PIPINGS
A200	AUDITORIUM NORTH ELEVATION
A201	AUDITORIUM EAST ELEVATION
A202	AUDITORIUM SOUTH ELEVATION
A203	PENTHOUSE & PARAPET ELEVATIONS
A500	WALL SECTIONS
A520	MASONRY RESTORATION DETAILS
A521	MASONRY RESTORATION DETAILS
A530	ROOF DETAILS
A531	ROOF DETAILS
A532	ROOF DETAILS
A800	RESTORATION PHOTOGRAPHS
A801	RESTORATION PHOTOGRAPHS
M000	HVAC COVERSHEET
M102	STAGE RADIATOR DEMOLITION PLAN – HVAC
M103	ROOF DEMOLITION PLAN – HVAC
ME202	STAGE RADIATOR PLAN – HVAC
M203	ROOF PLAN – HVAC
M500	HVAC DIAGRAMS AND SCHEDULES
E000	ELECTRICAL COVERSHEET
E203	ROOF PLAN – POWER AND SYSTEMS
E300	ELECTRICAL ELEVATION
E400	ELECTRICAL DETAILS
E600	ELECTRICAL SCHEDULES

END OF SECTION

SECTION 1.G

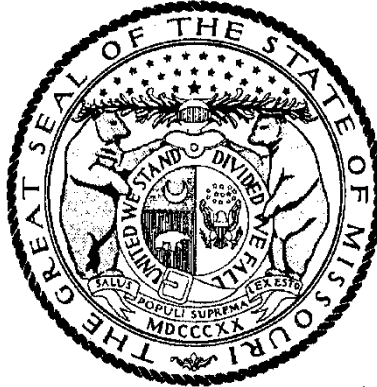
PREVAILING WAGE RATES

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.

SECTION 1.H

ALTERNATES

Base Bid may be increased in accordance with the following Additive Alternate proposal(s) as Owner may elect:

1. Additive Alternate No. 1: Relocate existing stage radiant heaters along the east interior wall face of the stage and attach to new framing attached to existing pilasters. Re: Sheets D110, A110, M102 and ME202.
2. Additive Alternate No. 2: Install new lightning protection system at the Auditorium Roof. Re: Sheets E203 and E400.
3. Additive Alternate No. 3: Base Bid scope shall be to disconnect and temporarily remove existing air handling unit on top of stage roof in order to replace the existing roof and unit curb. Alternate scope of work is to refurbish components of existing air handling unit before reinstalling on new roof curb. Re: Mechanical Sheets.
4. Additive Alternate No. 4: Install 5/8" substrate board on top of existing cast-in-place concrete roof deck at Roof "B" and "C" as shown on roof detail sheets.

UNIVERSITY of MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

HAZARDOUS BUILDING MATERIAL SURVEY

CP232811

JESSE HALL AUDITORIUM – ENVELOPE REPAIRS

10/2/2024

TO: Heather Brown

Planning, Design & Construction

FROM: Pete Kohler

Environmental Health & Safety

MU Environmental Health and Safety has completed a hazardous building material survey for specific parts of the building envelope of Jesse Hall Auditorium (Bldg. C37-243). The scope of the project will be:

the repair of the parapet wall, masonry and new roof on Jesse Hall....[including] the masonry at the parapet and the masonry tuckpointing along the North and East walls. Work under the masonry repair will be new brick, masonry tuckpointing, capstone replacement/repair and removal and replacement of the EPDM roof.

The roofing materials were surveyed in a previous survey, dated 8/5/2024. This survey deals with the rest of the project, including paint.

The asbestos inspection was conducted to satisfy the requirements of 40CFR 61, subpart M, which stipulates that all buildings be “thoroughly inspected” for asbestos before the commencement of renovation or demolition activities. The asbestos inspection was conducted by Pete Kohler (MO Asbestos Inspector #10883, expires 10/17/2024). The survey was conducted in September, 2024 and the report was completed October 2, 2024.

The project will not disturb asbestos-containing materials.

FIELD OBSERVATIONS

The north and east elevations of Jesse Auditorium are stone and brick walls. Masonry repairs at the parapet and new tuckpointing will not impact suspect material.

The junction of stone to brick is mortar. Bricks are laid conventionally and the mortar is not an asbestos concern.



I did not identify any suspect patching tar or other suspect materials that will be disturbed by this project.

Entry doors on the ground floor are wood, hung in wood jambs. The junction of the wood door jambs to the brick or stone walls is sealed with caulk. The caulk is many layers deep. The top layer is clearly silicone and is not suspect. However, the older caulk, deeper in the joint, is suspect. Samples were collected at several locations and analyzed. The caulk samples were found to contain asbestos in concentration lower than the amount required to qualify as asbestos-containing material (ACM). Asbestos law defines ACM as building material containing >1% asbestos. Each of the samples of caulk from Jesse Auditorium doors was found to contain <1% chrysotile asbestos. In a non-friable material like caulk, a tiny concentration of chrysotile allows the material to be dealt with as non-asbestos containing.

The previous survey, dealing with the roof contains information about caulk found on the roofing application. Virtually all the caulk I found is silicone, which is not suspect.

Two samples of caulk were analyzed and found negative for asbestos. While I was working on the roof for the lead survey in this report, I found an additional caulk, near the ladder mounted to the wall separating the two roofs. A sample was collected and analyzed. It is negative for asbestos, as well.

SAMPLE ID	LOCATION/DESCRIPTION	ANALYSIS
240924-01	Jesse Auditorium north side entry door – caulk between wood jamb and stone wall – TOP LAYER (white)	100% non-fibrous
240924-01a	Same location, caulk, BOTTOM LAYER (tan)	<1% chrysotile, 100% non-fibrous
240924-02	Same location, caulk at metal lintel over door (gray)	10% quartz, 90% non-fibrous
240924-03	Jesse Auditorium east side entry door (stage door) – caulk between wood jamb and stone wall – BOTTOM LAYER (tan)	<1% chrysotile, 100% non-fibrous
240924-04	Jesse Auditorium south side- door jamb caulk – TOP LAYER – (beige)	<1% chrysotile, 100% non-fibrous
240924-04a	Same location, caulk, BOTTOM LAYER (tan)	<1% chrysotile, 100% non-fibrous
240925-01	Jesse Auditorium Roof, parapet wall between two roofs at ladder – hard gray caulk	100% non-fibrous

ASBESTOS SUMMARY

The scope of the project will not disturb asbestos-containing material.



LEAD SURVEY

MU EHS has completed a lead survey of specific areas on the exterior of Jesse Auditorium. Painted surfaces on small structures on the roof are included.

The purpose of this survey is to identify lead paint that might represent a potential worker safety hazard and/or might require special handling and waste disposal prior to the demolition or renovation.

The EPA and the U.S. Department of Housing and Urban Development (HUD) consider lead-based paint as containing a lead concentration equal to or greater than 1.0 milligram per square centimeter (mg/cm²) or 0.5% lead by weight, as defined by Title X of the 1992 Housing and Community Development Act. The US Consumer Product Safety Commission considers paint with up to 600 ppm of lead to be "Lead Free".

Finished surfaces were tested for lead, using a Niton XRF analyzer. The XRF was checked before the survey and found to be in calibration. The survey was made by Pete Kohler (Missouri Lead Inspector #00783, expires 12/11/2025.) The lead survey was conducted in September and October, 2024.

As a result of the survey, some finished surfaces were identified having lead in concentrations which reach the HUD standard.

Painted metal surfaces on structures on the roof have lead-based paint.
White wood door jambs on the ground floor entries have lead-based paint.

On the north elevation, but facing east, there is an entry door not shown on the plans for the project. It is six feet west of the entry door facing north. The white wood door has lead-based paint that approaches the HUD standard, but does not qualify as lead-based. OSHA has found that certain work, including aggressive disturbance of the painted surface, may result in lead levels exceeding the Action Level or the Permissible Exposure Limit (PEL)- even when the concentration is below 1 mg/cm².

LOCATION/DESCRIPTION	LEAD READINGS (mg/cm ²)
Jesse Auditorium Roof – white metal painted fire door onto roof – from brick structure top of stairs from space above stage	9.53, 13.00
Jesse Auditorium Roof – white metal painted panels on shed – west side	1.65, 8.53, 0.65, 0.36
White painted panels on shed - east side	0.04, 9.67, 11.65
White metal downspout on shed	8.83
White metal hatch cover	1.06, 1.05
White metal ladder over parapet dividing wall	0.37, 1.08, 1.36
Black metal vent stack, painted	3.88, 4.12
Gray metal panels on structure behind entry hut	0.06, 0.05, 0.06, 0.01



Jesse Auditorium, ground floor, entry doors north side, white wood doors	0.01, 0.01, 0.01, 0.01, 0.01
North side, white metal lintel	0.03, 0.05, 0.03
North side, white wood door jambs	2.31, 1.15, 1.57
North elevation, entry doors facing east (NW corner of auditorium) white wood doors	0.77, 0.15, 0.58, 0.80
White metal lintel	0.05, 0.05, 0.05
White wood door jambs	2.53, 1.93
North side, white metal garage door	0.01, 0.01, 0.01, 0.01, 0.01
White metal door frame	0.01, 0.01, 0.01, 0.01, 0.01
Entry doors east side (stage door), white wood door	0.03, 0.02, 0.03, 0.02
White wood door jambs	1.83, 1.64
East side entry doors (SE corner), white wood door	0.1, 0.25, 0.32, 0.49, 0.54, 0.13
White wood door jamb	2.77, 2.79, 3.5

LEAD SUMMARY

Painted surfaces on the roof of Jesse Auditorium have lead-based paint.

White wood door jambs on the ground floor are painted with lead-based paint. Readings for the wood doors at the southeast corner and the northwest corner of the auditorium approach the HUD standard for lead-based paint.



TECHNICAL SPECIFICATIONS - UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

For

**UNIVERSITY OF MISSOURI
PROJECT CP232811
JESSE AUDITORIUM ENVELOPE
REPAIRS**

Prepared for

**UNIVERSITY OF MISSOURI
Campus Facilities
Columbia, Missouri 65211**

Prepared by

**UNIVERSITY OF MISSOURI
ENVIRONMENTAL HEALTH & SAFETY**

PART 1 - GENERAL

Provisions of the General Conditions and Special Conditions are part of this Division.

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 The Contractor shall inform him/herself of the conditions for the project, and is responsible for verifying the quantities and location of all work to be performed as outlined in this section. Failure to do so shall not relieve the Contractor of his obligation to furnish all materials and labor necessary to carry out the provisions of the Contract. The work of the Contract can be summarized as follows:

The work consists of the proper removal of the following approximate quantities of hazardous materials from Jesse Auditorium – Envelope Repairs.

Demolition/Construction Waste

Hazardous Waste

N/A

Universal Waste

N/A

Reclaim/Recycle

N/A

Building Materials Painted with Regulated Heavy Metals

Painted metal structures on the roof are lead-based paint, including stage ventilator enclosure, hatch cover, metal ladder, vent stack, fire entry door onto roof

The LBP covers one thousand, eight hundred (1,800) square feet.

(The gray metal shed is not lead-based. It looks like bare sheet metal, but is painted gray. The gray paint is not lead-based.)

White wood door jambs on the ground floor exterior doors are lead-based paint.

There are six (6) sets of doors. The doors into the basement are double doors. The doors are not lead-based. The jambs are lead-based.

Lead-based paint covers two hundred fifty four (254) square feet.

Radioactive Lab History/Activity

N/A

1.2 **CODES AND REGULATIONS:**

1.1.2.1 All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

1.1.2.2 Federal and State requirements which govern universal and hazardous removal work or hauling and disposal of such waste materials include but are not limited to the following:

1.1.2.2.1 U.S. Department of Labor, Occupational Health and Safety Administration (OSHA), 29 CFR 1910 and 29 CFR 1926.

1.1.2.2.1.1 Construction Industry - 29 CFR 1926.1101

1.1.2.2.1.2 Respiratory Protection – 29 CFR 1910.134

1.1.2.2.1.3 Hazard Communication – 29 CFR 1910.1200

1.1.2.2.1.4 Accident Prevention Signs – 29 CFR 1910.145

1.1.2.2.2 U.S. Environmental Protection Agency (EPA)

1.1.2.2.1.5 1.1.3 **CONTRACTOR'S DUTIES**

1.1.3.1 Except as specifically noted, provide and pay for:

- Labor, materials, and equipment.
- Tools, construction equipment, and machinery.
- Other facilities and services necessary for proper execution and completion of work.

1.1.3.2 Pay legally required sales, consumer, use, payroll, privilege and other taxes. Retail sales tax shall not be included in the bid amount.

1.1.3.3 Secure and pay for, as necessary for proper execution and completion of work, and as applicable at the time of bids:

- Permits
- Government Fees
- Licenses
- Except where specifically noted, provide and pay for waste

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disposal permits and costs

- 1.1.3.4 Give required notices.
 - 1.1.3.5 Contractor shall assume full responsibility and liability for compliance with all codes, ordinances, rules, regulations, orders and other legal requirements of Local, State, and Federal public authorities including Environmental Protection Agency (EPA) regulations, Missouri Department of Natural Resources (MDNR) and Occupational Safety and Health Administration (OSHA) which bear on performance work. Where conflicts occur between these specifications and/or the above-mentioned regulations, the more stringent shall govern. The Contractor shall hold the owner and owner's air monitoring firm harmless for failure to comply with any applicable work, hauling, safety, health, or other regulations on the part of the contractor, contractor's employees, or contractor's subcontractors.
 - 1.1.3.6 If the Contractor observes that any of the Contract Documents are at variance therewith in any respect, he shall promptly notify MU in writing, and any necessary changes shall be accomplished by appropriate modification. It is not the Contractor's responsibility to make certain that the Contract Documents are in accordance with applicable laws, statutes, building codes and regulations. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to MU, he shall assume full responsibility therefore and shall bear all cost attributable thereto.
 - 1.1.3.7 Enforce strict discipline and good order among employees. Do not employ unfit persons or persons not skilled in assigned task.
 - 1.1.3.8 Comply with all applicable federal, state, and local laws regarding job discrimination and payment of prevailing wage rates for the base bid.
 - 1.1.3.9 The use of the best available technology, procedures, and methods for preparation, execution, cleanup, disposal, and safety are absolutely required. This compliance is the sole responsibility of the abatement contractor.
 - 1.1.3.10 Assume responsibility for the proper and safe execution of the work.
- 1.1.8 **COORDINATION**: The hazard remediation contractor shall be responsible for the coordination of the universal/hazardous materials removal for this project. The hazard remediation contractor shall coordinate with all other on-site contractors and all subcontractors working under separate contracts so as to facilitate the general progress of the work. Each trade shall afford all trades every reasonable opportunity for the installation of their work.

1.2 STOP WORK

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- 1.2.1 If the Owner, or his designated representative, presents a written or verbal stop work order, immediately stop all work or that portion of the work designated. A verbal stop work order shall be confirmed by a written stop work order within 24 hours. Do not commence referenced work until authorized in writing by the Owner or his representative.

1.3 CONTRACTOR USE OF PREMISES

- 1.3.1 **GENERAL:** During the construction period for each building, the hazard remediation contractor will have full access to Jesse Auditorium - Envelope for construction operations. Owner will keep the elevators operational.

- 1.3.2 **USE OF THE SITE:** Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

1.3.2.1 Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times. Contractor will be allowed to use the parking lot to the north of the building for parking and/or storage of materials.

1.3.2.2 Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage to areas acceptable to Owner. If additional storage is necessary, obtain and pay for such storage off-site.

1.3.2.3 Do not load structure with weight that will endanger structure.

1.3.2.4 Assume full responsibility for protection and safekeeping of products stored on premises.

1.3.2.5 Move any stored products which interfere with operations of Owner or other contractors.

1.3.2.6 Contractor personnel shall utilize only those entrances/exits and parking lots designated by the Owner.

1.3.2.7 Contractor shall utilize only those areas designated by the Owner for the storage of equipment and the placement of dumpsters/transport containers.

1.3.2.8 Take all cautions necessary to ensure there is no universal and hazardous material contamination to those areas not included in work schedule. Should areas outside the work area become contaminated with hazardous materials, the Contractor shall immediately clean them utilizing the wet cleaning and HEPA vacuum methods specified herein. The hazard remediation contractor is responsible for the proper cleanup of all items in the work areas to maintain a clean and safe environment.

- 1.3.3 **CONTRACTOR'S USE OF THE EXISTING BUILDING:** Maintain the existing

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building in a safe and weather tight condition throughout the construction period. Take all precautions necessary to protect the building and its occupants during the construction period.

1.3.3.1 Keep areas such as walkways and stairs free from accumulation of waste material, rubbish or construction debris.

1.3.3.2 Smoking or open fires are prohibited within the building or on the premises.

1.4 OWNER OCCUPANCY

1.4.1 PARTIAL OWNER OCCUPANCY: The Owner reserves the right to occupy areas of the building in which universal/hazardous waste removal has been completed, provided that such occupancy does not substantially interfere with completion of the work. The Owner also reserves the right to occupy portions of the building not involved in this Scope of Work. Such partial occupancy shall not constitute acceptance of the work or any part of the work. The Owner shall also maintain the right to access areas where no universal and hazardous waste work is being performed.

2.1 SUBMITTAL REQUIREMENTS

2.1.1 The following will be submitted by the contractor prior to commencement of work for approval by Owner's Certified Industrial Hygienist (one copy for the Owner's Representative). The Owner's C.I.H. will return reviewed copies to contractor and Owner's Representative.

2.1.1.1 One copy of any Safety Data Sheets (SDS) for products to be used by the contractor in the performance of his work. Contractor will also maintain copies of SDS on site per OSHA.

2.1.2 Submit the following for all Supervisor(s) and Workers who will be on the project site prior to commencement of work:

2.1.2.1 A list of project personnel and contact phone numbers

2.1.2.2 Current training certificates, if applicable

2.1.2.3 Physician's Statement that each person is physically fit to wear a respirator, if respirator use is required

2.1.2.4 Respirator Fit Test, if respirator use is required

2.1.3 Submit a detailed plan of the procedures proposed for use in complying with requirements of this specification. Include in the plan the layout and location of work areas, route of ingress and egress for the work areas, methods used to assure safety of building occupants and visitors, method of removal of material, and disposal container requirements for lead based paint material to be disposed.

2.1.4 Proposed disposal site for lead-based paint materials, including a disposal plan to detail type of disposal container, method of transportation to disposal site, and

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waste hauler.

- 2.1.5 Any other submittals as required by MU.
- 2.1.6 Upon completion of the universal/hazardous material removal, submit to the Owner's Representative, copies of hazardous materials shipping records, disposal receipts, incineration documentation, etc. for all hazardous materials removed from the project site.
- 2.1.7 Upon completion of the universal waste/hazardous material removal, the following information shall be submitted by the Owner's C.I.H. to the contractor:
 - 2.1.7.1 Construction and demolition waste landfill receipts, disposal receipts, truck tickets, incineration/recycling receipts and documentation.
 - 2.1.7.2 Written visual certification from the Owner's Certified Industrial Hygienist that universal waste/hazardous material have been removed from the facility.

2.2 TERMINOLOGY (Definitions)

- 2.2.1 **APPROVED Construction and Demolition WASTE DISPOSAL SITE:** A permitted solid waste landfill that is authorized by the Missouri Department of Natural Resources to receive construction and demolition wastes.
- 2.2.2 **AUTHORIZED VISITOR:** The Building Owner, the Building Owner's representative, MU personnel, or a representative of any regulatory or other agency having jurisdiction over the project.
- 2.2.3 **BARRIER:** Any surface that seals off the work area to non-authorized personnel from entering the work area.
- 2.2.4 **BUILDING OWNER:** A representative of the University of Missouri.
- 2.2.5 **DISPOSAL CONTAINER:** A properly labeled container for universal/hazardous materials. The proposed disposal container for lead-based paint will be provided to the Owner's Representative and part of the hazard remediation contractor's pre-work
- 2.2.6 **HEPA VACUUM EQUIPMENT:** High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining hazardous particulates. Filters should be of 99.97% efficiency for retaining particulates greater than 0.3 microns.
- 2.2.7 **ON-SITE REPRESENTATIVE:** MU's full-time representative responsible for air monitoring and enforcement of the specifications.
- 2.2.8 **OWNER'S CERTIFIED INDUSTRIAL HYGIENIST (C.I.H.):** An Industrial Hygienist, certified in comprehensive practice by the American Board of Industrial Hygiene (ABIH).
- 2.2.9 **HAZARDOUS MATERIAL SHIPMENT RECORD/DISPOSAL RECEIPT:** The

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shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of universal/hazardous materials.

- 2.2.10 **WET CLEANING/WIPING:** The process of eliminating contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as necessary.
- 2.2.11 **WORK AREA:** A specific isolated area in which universal/hazardous waste materials are required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

2.3 EXISTING CONDITIONS

- 2.3.1 Building Owner and Contractor shall agree on building conditions prior to commencement of work. It shall be the Contractor's responsibility to replace or repair to the Owner's satisfaction, prior to close-out of the project, all damaged items caused by the Contractor and not proven otherwise. All items damaged prior to remediation shall be noted during preconstruction walk-through.

3.1 PERSONNEL PROTECTION REQUIREMENTS

- 3.1.1 Prior to commencement of work, the workers shall be instructed and shall be knowledgeable on the hazards of the universal hazardous materials involved and other environmental exposures, use and fitting of respirators, protective clothing, decontamination procedures, and all aspects of remediation work procedures; workers shall have medical examinations.
- 3.1.2 The Contractor acknowledges that he alone is responsible for enforcing personnel protection requirements and that these specifications provide only a minimum acceptable standard for each phase of operation.
- 3.1.3 If required or requested of the workers, provide workers with personally issued and marked respiratory equipment approved by NIOSH and accepted by OSHA.
- 3.1.4 No visitors shall be allowed in work areas, except as authorized.
- 3.1.5 Where required or if requested by the workers, provide workers with sufficient sets of disposable protective full-body clothing. Such clothing shall consist of full-body coveralls, footwear, and head gear, one-piece coveralls or equal. Provide eye protection and hard hats as required by applicable safety regulations. Disposable clothing shall not be allowed to accumulate and shall be disposed of as contaminated waste.
- 3.1.6 Provide authorized visitors with suitable protective clothing, headgear, footwear, and gloves as described above whenever they are required to enter the work area.

3.2 MATERIALS

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- 3.2.1 Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.
 - 3.2.1.1 Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.
 - 3.2.1.2 Damaged or deteriorating materials shall not be used and shall be removed from the premises.
- 3.2.2 **PLASTIC SHEETING**: A minimum 6-mil (or as specified).
- 3.2.3 **TAPE**: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheets to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water, duct tape, poly prep tapes or approved equal.
- 3.2.4 **ADHESIVES**: Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water.
- 3.2.5 **IMPERMEABLE CONTAINERS**: Suitable to receive and retain any hazardous materials until disposal by the owners rep. The containers shall be labeled as required by owner. Containers must be resistant to damage and rupture.
- 3.2.6 **WARNING LABELS AND SIGNS**: As required by owner.
- 3.2.7 **OTHER MATERIALS**: Provide all other materials, such as, but not limited to lumber, plywood, nails, and hardware, which may be required to properly prepare and complete this project.

3.3 TOOLS AND EQUIPMENT

- 3.3.1 Provide suitable tools for universal/hazardous waste removal and disposal.
 - 3.3.1.1 **Water Sprayer**: Airless or a low pressure sprayer for amended water application as applicable.
 - 3.3.1.2 **Air-Purifying Equipment**: High Efficiency Particulate Air Filtration Systems (HEPA) shall comply with ANSI Z9.2-91. No air movement system or air equipment should discharge particulates outside the work area. Thus, the negative air unit shall be equipped with a three filter bank with the last being the HEPA filter capable of removing 99.97% of fibers/particulates >0.3 microns.
 - 3.3.1.3 **Scaffolding**: As required to accomplish the specified work and meet all applicable safety regulations.
 - 2.3.1.4 **Vacuums**: Use HEPA type from a known manufacturer.
 - 2.3.1.5 Other tools and equipment as necessary.

3.4 SUPERVISION OF UNIVERSAL/HAZARDOUS Material REMOVAL

- 3.4.1 The contractor shall designate a competent supervisor subject to the approval of the Owner's C.I.H. and the Owner's Representative. The supervisor shall be the Contractor's representative on the project, shall meet the requirements of all applicable regulations, and perform or meet the following minimum requirements:
- 3.4.1.1 Be knowledgeable in all aspects of removal, cleanup and proper disposal of universal hazardous materials as listed in the Scope of Work.
 - 3.4.1.2 Be onsite and supervise all removal, cleanup and disposal activities.
 - 3.4.1.3 Maintain a daily log on the project documenting events, violations, problems, equipment failures, accidents, and inspections.
 - 3.4.1.4 Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.
 - 3.4.1.5 Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Certified Industrial Hygienist. Inspection shall be documented.

3.5 WORKER PROTECTION / TRAINING

- 3.5.1 The contractor shall be responsible for providing his employees with proper respiratory protection, respiratory training, a written respirator program, medical examinations, maintaining medical records, protective clothing and equipment to comply with OSHA requirements, if necessary
- 3.5.2 All workers shall be trained in the dangers inherent in handling universal waste, and hazardous materials, in proper work procedures, and personal protective measures.

3.6 OWNER'S CERTIFIED INDUSTRIAL HYGIENIST

- 3.6.1 It will be the Owner's responsibility to hire a Certified Industrial Hygienist. The Certified Industrial Hygienist will also be required to perform the following duties as a minimum:
- 3.6.1.1 Approval of the Contractor's work plan and methods of remediation to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.
 - 3.6.1.2 Verify that the Contractor is satisfactorily performing the work in accordance with OSHA regulations.
 - 3.6.1.3 Visual inspection of the work areas.
 - 3.6.1.4 Certify in writing that the Contractor's procedures, methods, and practices were, to the best of his/her knowledge and belief, in compliance with current EPA, OSHA, State, and Local applicable regulations, that the work areas meet the requirements for a final visual

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inspection prior to re-occupancy, and an accounting of any known deviations.

3.7 SEPARATION OF WORK AREAS FROM NONWORK AREAS

3.7.1 Visual separation shall be accomplished at all "see-through" locations using opaque polyethylene. This separation shall not be incorporated within the other seals involved on this project.

3.8 EMERGENCY PROTECTION PLAN / FIRE EXITS

3.8.1 The contractor shall be responsible for developing a written Emergency Protection Plan and shall maintain this plan onsite. The plan shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, falls, and heat related injury. All employees shall be instructed and trained in the procedures.

3.8.2 The Emergency Protection Plan shall also include written notification of police, fire, and medical personnel of the planned remediation activities, work schedule, and layout of the work area, particularly barriers that may affect response capabilities.

3.8.3 Designate and maintain emergency and fire exits from the work area in accordance with local codes and regulations. All exits shall be clearly marked with fluorescent tape or red paint and shall be clearly visible from any part of the work area.

3.9 LOCAL AREA PROTECTION / SITE SECURITY

3.9.1 The contractor shall secure the work areas to make sure of no inadvertent entry. Any breach to the exterior of the building shall be secured by the hazard remediation contractor. The Contractor shall be responsible for maintaining security of the remediation areas throughout the contract period.

3.9.2 The contractor shall be responsible for all areas of the building used by contractor and/or subcontractors in the performance of the work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of the existing building, except such controls as may be specifically reserved to the owner.

3.9.3 Contractor has the right to exclude from the work area all persons who have no purpose related to the work or its inspection, and shall require all persons in the work area to observe the same regulations required of Contractor's employees.

3.9.4 The contractor shall have control of site security during remediation operations in order to protect the work environment and equipment. Contractor shall have the owner's assistance in notifying building occupants of impending activity and enforcement of restricted access by owner's employees.

3.9.5 The contractor shall keep a minimum of two (2) 10lb type ABC fire extinguishers onsite. One shall be maintained outside the work area and one inside each work area. Contractor employees shall be trained in the operation of fire

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extinguishers.

- 3.9.6 The contractor shall maintain the work area free from rubbish, debris, and dirt, and keep a clean, safe working area.

3.10 UNIVERSAL WASTE/HAZARDOUS MATERIALS REMOVAL OPERATIONS

- 3.10.1 Any light fixtures, housings, etc. concealing items considered to be universal waste/hazardous material shall be removed, containerized, labelled, and left on site for disposal by MU EHS. This does not include refrigerant or CHC/HCFE-containing equipment which are being replaced by the contractor. It does not include TCLP ceramic tile, which should be handled by the contractor.

3.10.2 **MATERIALS PAINTED WITH RCRA-Metals PAINT –**

It is anticipated that these items will be removed as part of the demolition process and will be segregated from the remainder of the demolition debris. It is anticipated that these items will be hauled away and disposed of in a sanitary landfill approved by the State of Missouri to accept construction and demolition waste. These areas should be sealed off with polyethylene sheeting over the doors, vents, windows, or any other openings into/out of the area.

- 3.10.3 **FLUORESCENT LIGHT TUBES** may contain small amounts of Mercury. This can potentially be harmful to human health and the environment. The bulbs should be placed in fiberboard boxes provided by MU EHS to minimize breakage. MU EHS will manage disposal of this material.

- 3.10.4 **POLYCHLORINATED BIPHENYL (PCBS)** are a known carcinogenic material. Its use was discontinued January 1, 1979. Due to the age of the building, it should be assumed that any ballast can contain PCBs unless it is labeled as PCB free by the manufacturer. Due to this, any light ballasts presumed to contain PCBs should be properly disposed of. MU Environmental Health and Safety will provide collection container for this purpose. Non-PCB ballasts will also be managed by MU Environmental Health and Safety. Collection containers will be provided to the contractor upon their request.

- 3.10.5 **SMOKE DETECTORS** are typically ionization smoke detectors that may contain a small amount of radioactive material. MU Environmental Health and Safety will provide collection containers for this material and will also be responsible for the disposal of this material.

- 3.10.6 **FIRE ALARMS (STROBE LIGHT)** are typically not considered a universal or

hazardous waste. However, for the purposes of this project, these items should be collected by the contractor and managed by MU Environmental Health and Safety. Collection containers will be provided to the contractor upon their request.

- 3.10.7 **EXIT SIGNS AND EMERGENCY LIGHTS** typically have backup batteries that may contain small amounts of lead. Some exit signs are powered by a small amount of radioactive material. Powered exit signs and emergency lights should have the battery removed and disposed of by MU Environmental Health and Safety. Non powered exit signs should be assumed to contain radioactive material and should be collected for disposal via MU Environmental Health and Safety. MU Environmental Health and Safety will provide collection containers for these items.
- 3.10.8 **DRINKING FOUNTAINS**: Some drinking fountains have reservoirs that may contain lead and a CFC/HCFC refrigerant that must be recovered. The lead reservoirs should be removed and recycled. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.
- 3.10.9 **DOOR CLOSURES**: Some of the older door closures have oil reservoirs for lubrication. These oils may contain small amounts of PCBs. MU Environmental Health and Safety will provide a collection container for this material, and will be responsible for disposal.
- 3.10.10 **THERMOSTATS** may contain Mercury. This can potentially be harmful to human health and the environment. Mercury containing thermostats shall be disposed of as a hazardous waste. MU EHS will provide a collection container for this material, and will be responsible for disposal.
- 3.10.11 **WINDOW AIR CONDITIONING UNITS**: Where possible, these window units should be removed and stored for use elsewhere. Otherwise these units may contain CFC/HCFC refrigerants that must be recovered. CFC/HCFC refrigerants are suspected to damage the atmosphere. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.

3.12 REESTABLISHMENT OF THE WORK AREA

- 3.1-2.1 Reestablishment of the work area shall only occur after the Contractor has received a final visual inspection from the Owner's C.I.H. documenting that the universal/hazardous waste materials have been removed from the project site.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Demolition and removal of selected portions of building.
 2. Salvage of existing items to be reinstalled.

1.2 DEFINITIONS

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

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. 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.

- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations.

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

1.6 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

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.

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- B. Standards: Comply with ANSI/ASSP 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 preconstruction photographs or video.
1. Inventory and record the condition of items to be removed and salvaged.
 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- 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. 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.
 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and 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. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 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. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- 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.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least 3 hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 10. 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 Reinstalled Items:

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

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

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts. Scan for existing reinforcement prior to cutting concrete roof or curbs and report results to project Structural Engineer.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075323 EPDM Roofing for new roofing requirements.
1. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- 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.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 045000 – EXTERIOR HISTORIC MASONRY RESTORATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including the Conditions of the Contract and General Requirements, apply to the work specified in this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Natural limestone restoration including stone patching, pinning, resetting limestone, crack injection, void grout injection, dutchman repairs, and limestone replacement.
 - 2. 100% raking and repointing of all mortar joints with custom historic pointing mix.
 - 3. Removal of damaged bricks and toothing in new and salvaged bricks.
 - 4. Through-wall and coping flashing.
 - 5. Repair or removal and replacement of steel lintels.
 - 6. Repairs and Reconstruction of brick parapet walls.
 - 7. 100% cleaning of all exterior masonry surfaces.
 - 8. Severe soiling and algae growth cleaning.
- B. Related Requirements:
 - 1. Section 079200 – “Joint Sealants”
 - 2. Section 051200 – “Structural Steel Framing”

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in 1.A Bid Lump Sum Contract, Section 3. Bid Pricing, Subsection C. Unit Prices.
 - 1. Unit prices apply to authorized work covered by estimated quantities.
 - 2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders

1.4 DEFINITIONS

- A. Dutchman: as used herein refers to a portion of new or salvaged stone fitted into an existing stone to produce an intact contiguous surface.
- B. Stone-to-Stone: repairs refer to conditions where the original stone piece still exists and can be pinned directly back to its original location or to its mated portion.
- C. Hot Weather Stone Masonry Restoration: as used herein refers to work of this Section when temperature is above 100 deg F or when temperature is above 90 deg F and wind is above 8 mpg or when either of these conditions is predicted within 48 hours of use of mortar.

- D. Saturated, surface dry: Wet surfaces to receive mortar to ensure that surfaces are damp but free of standing water.
- E. Repointing: The process of raking out (removing) mortar and replacing it with new mortar.
- F. Low-Pressure Saturation Spray: 60 psi; 1-1/2 – 2 gpm per spray head.
- G. Low-Pressure Warm Water Wash: 100 to 400 psi; 4 – 6 gpm at 180 deg F.
- H. Medium-Pressure Warm Water Wash: 800 to 1200 psi; 4 – 6 gpm at 180 deg F.

1.5 PRE-RESTORATION MEETINGS

- A. Pre-restoration Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to repairing historic stone and masonry including, but not limited to, the following:
 - a. Verify historic treatment specialist's personnel and equipment needed to make progress and avoid delays.
 - b. Materials, material application, sequencing, tolerances, and required clearances.
 - c. Quality-control programs.
 - d. Masonry historic treatment program.

1.6 QUALITY ASSURANCE

- A. The masonry restoration subcontractors performing work under this section have been pre-qualified by the owner. Only pre-qualified masonry restoration subcontractors are allowed to bid and perform this scope. All pre-qualified masonry subcontractors shall provide the staff and other resources itemized in their response to the Owner's pre-qualification RFQ.

The following masonry restoration subcontractors have previously submitted their qualifications and have been approved by the owner to perform the masonry restoration scope. Only subcontractors included on this list may perform the masonry restoration scope.:

- 1. Bulley & Andrews Masonry Restoration (BAMR)
1755 Armitage Avenue
Chicago, Illinois 60622
(773) 235-2433
- 2. Pullman
10150 N Ambassador Drive, Suite 200
Kansas City, MO 64153
(816) 231-7400
- 3. MTS Contracting Inc
1019 Swift Ave
N. Kansas City, MO 64116
(816) 421-6969

- B. Table One generally itemizes the scope and work tasks to be performed by the masonry restoration subcontractors. Table One is not intended to encompass all work required by the masonry restoration subcontractor for a complete project, but it does delineate the major tasks

for which the respective subcontractors have been approved to perform. It is the Contractor's responsibility to ensure all work is sufficiently complete regardless of the delineation in Table One.

Table One – Scope Description for Masonry Restoration Subcontractors:

1. Masonry Restoration Scope:
 - a. Removal, salvage and re-building of the brick veneer of the parapet walls indicated.
 - b. 100% Raking existing mortar joints
 - c. 100% Pointing mortar joints
 - d. Replacement of cracked or damaged stones and bricks.
 - e. Removal and tooth-in of masonry at areas damaged during replacement of rusted steel lintels
 - f. 100% cleaning of all exterior stone and brick building surfaces
 - g. Patching, restoring, pinning damaged stones
 - h. Replacement of all damaged steel lintels & associated masonry work.
 - i. Removal, salvage and re-setting of stone copings with new thru-wall flashings.
 - j. Removal, salvage and re-setting of brick veneer with new thru-wall base flashings and anchors.
 - k. Installation of control and movement joints.
 - l. Any other masonry restoration work called for on the drawings

- C. Submit a resume for each of the persons who will be supervising and performing the work of this Section demonstrating a minimum of 3 years experience working in their trades, list of three example projects describing the work the person has performed with relative restoration scopes. Only individuals whose resumes have been submitted, reviewed and accepted by the Architect will be allowed to perform the work of this Section.

- D. Testing of Workers: Technicians proposed for raking and cutting joints in historic masonry of this Project shall be required to successfully complete six square feet of raking and cutting mortar joints in presence of Architect prior to working on Project. Unsuccessful performance in this test area will be grounds for rejection of this technician for joint preparation and pointing work on this Project.

- E. Architect may randomly select areas of tuck-pointing to be raked for verification of the appropriate depth of pointing and void filling. Contractor shall bear the cost of repointing these areas of selected destructive testing in their base bid.

- F. Source of Materials: Obtain materials for masonry restoration from a single source for each type of material required to ensure match of quality, color, pattern, and texture.

- G. Documentation of Existing Conditions: Document configurations and conditions of stone masonry units indicated to be restored before beginning restoration with photographs showing overall units and with additional detail photographs showing areas of damage and deterioration to be repaired if such areas are not clearly visible and understandable in the overall photographs of the stone units.
 1. Images: Clear, sharp, high-resolution, color images. Unclear images, out-of-focus images, underexposed images, and overexposed images will not be accepted.
 2. Identification and Keying: Label each photograph with project name, date, and time photograph was taken, and location. Key detailed photographs to overall photographs and to drawings. Clearly show all existing conditions, including conditions that might be misconstrued as damage resulting from work of this Section

3. Labeling: Label each salvaged masonry unit using approved method that will identify unit until completion of the work and that will not be visible when masonry unit is reinstalled in finished work.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Submit manufacturers' technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportion), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Material Safety Data Sheets.
 - a. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C67.
 2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Quality Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.
- C. Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used to for each phase of the historic treatment work including protection of surrounding materials and Project site.
 1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.
 2. Do not begin work on site until Architect has approved Masonry Historic Treatment Program in writing. Photocopies of Contract Documents, excerpts from Contract Documents and/or duplication of text in Contract Documents will not be accepted for Work Description. Description for each type of restoration on each material shall include, but not be limited to:
 - a. Materials and Procedures: Materials, methods, tools, and equipment to be used for each phase and task of stone masonry restoration work.
 - 1) Include methods for keeping exposed mortar damp during curing period.
 - b. Protection: Description, including drawings, and diagrams, of proposed materials and methods of protection for preventing harm, damage, and deterioration caused by work of this Section to persons (whether involved in the Work or not); building elements, materials, and finishes, surrounding landscape and site, and the environment (including air and water).
 - 1) Include procedures for controlling noise and dust.
- D. Samples for Initial Selection: For the Following:
 1. Patching Mortar: Submit sets of each type of patching mortar samples in the form of plugs (patches in drilled holes) in sample units of stone representative of the range of stone colors on the building.

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- a. Have each set contain a close color range of at least three samples of different mixes of patching mortar that matches the variations in existing stone when cured and dry.
 2. Custom Historic Pointing Mortar: Submit sets of each type of mortar for pointing in the form of sample mortar strips, 6 inches (150 mm) long by ½ inch (13 mm) wide, set in aluminum or plastic channels.
 - a. Have each set contain a close color range of at least three samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.
 - b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each sample was made.
 3. Brick, in the form of straps of five or more bricks.
 4. Limestone to Match Existing Limestone: 12-inch x 12-inch x 1-inch pieces, finished to match existing.
 5. Each type of Dutchman stone. Include sample to show color, texture, grain, veining, and finish to be expected. Provide set of at least two 12-by-12-inch-by 1-inch (300-by-300-mm) samples, finished to match existing.
 6. Stainless steel flashing, including drip edge and termination bar.
- E. Shop Drawings: Dimensioned detailed scale drawings appropriate scales to clearly describe stone masonry restoration; details of anchors and fasteners, 3-inches equals 1-foot scale, minimum. Submit newly prepared drawings showing site-verified conditions and materials. Photocopies of Contract Documents and/or electronic scans of Contract Documents will not be accepted for Shop Drawing submittals.
1. Fabricated Flashing: Detail corner units, end-dam units, and other special applications for copper laminated flashing and stainless steel flashing.
- F. Field Construction Mock-Ups
1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 3. Prior to start of general masonry restoration, prepare the following sample panels on the building where directed by the Architect. Obtain Architect's acceptance of visual qualities before proceeding with the work. Retain acceptable panels in undisturbed condition, suitable marked, during construction as a standard for judging completed work. All costs associated with producing multiple samples shall be included in the base bid.
 - a. Cleaning: Demonstrate materials & methods to be used for each type of cleaning required, of masonry surface and condition of sample panels of approximately 25 sq. ft.
 - 1) Test adjacent non-masonry materials for possible reaction with cleaning materials.
 - 2) Allow waiting period of duration indicated, but not less than 7 calendar days, after completion of sample cleaning to permit study of sample panels for negative reactions.
 - b. Repointing: Prepare 3 separate sample areas of approximately 3'-0" high by 6'-0" wide for each type of repointing required, one for demonstrating methods and quality of workmanship expected in removal of mortar from joints and the other 2 for demonstrating quality of materials and workmanship expected in pointing mortar joints and for matching existing mortar joint color and texture.
 - c. Provide approximately 5'-0" linear feet of soft joint consisting of selected sealant with masonry sand rubbed on fresh sealant to simulate and match adjacent mortar units.

- d. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:
 - 1) Partial Stone Replacement: One partial stone replacement dutchman repair.
 - 2) Crack Injection: Apply crack injection in two separate areas as directed.
 - 3) Patching: Up to three small areas for limestone directed by Architect.
 - 4) Delamination to be Pinned and Patched: Two areas as directed.
 - 5) Major Crack Repairs: Apply major crack repairs in two separate areas.
- e. Brick Removal and Rebuilding: Sample area up to 25 sq. ft. at location determined by Architect.

1.8 INFORMATIONAL SUBMITTALS

- A. Preconstruction Photographs: Before commencement of restoration of Jesse Auditorium, Contractor shall take photographs of Project site and surrounding properties, including detailed documentation of the existing masonry conditions within the project scope. Refer to Quality Assurance Article above.
- B. Submit the following items in time to prevent delay of the work and to allow adequate time for review and resubmittals, if needed; do not order materials or start work before receiving the written approval:
 - 1. Written certificates from the historic pointing mortar Manufacturer shall be submitted stating that all installers of the pointing mortar have successfully completed the training workshop for installation of the mortar.
 - 2. Samples of all specified materials and Material Safety Data Sheets (MSDS) as appropriate.
 - 3. Certificates, except where the material is labeled with such certification, by the producers of the materials, that all materials supplied comply with all the requirements of these specifications and the appropriate standards.
 - 4. Written verification that all specified items will be used. Provide purchase orders, shipping tickets, receipts, etc. to prove that the specified materials were ordered and received.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on existing mortar as follows.
 - 1. Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use x-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by Architect.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stone units to Project site strapped together in suitable packs or pallets or in heavy-duty crates and protected against impact and chipping.

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- B. Deliver each piece of stone with code mark or setting number on unexposed face using non-staining paint.
 - C. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
 - D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
 - E. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
 - F. Store lime putty covered with water in sealed containers.
 - G. Handle stone to prevent overstressing, chipping, defacement, and other damage.
 - H. Store sand where grading and other required characteristics can be maintained and contamination avoided.
 - I. Protect masonry restoration materials during storage and construction from wetting by rain, snow, or ground water, and from staining or intermixture with earth or other types of materials.
 - J. Protect materials from deterioration by moisture and temperature. Store in a dry location or waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

1.11 FIELD CONDITIONS

- A. General
 - 1. Weather Requirements: Manufacturer's Recommendations: Perform work only when temperature of products being used, temperatures of existing and new materials and surfaces, and temperature and humidity of air at Project site comply with manufacturer's written instructions and specified requirements.
 - a. Clean masonry surfaces only when air temperatures are 40 deg. F and above and will remain so until masonry has dried out, but for not less than 7 days after completion of cleaning.
 - b. Repair stone units only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
 - c. Proprietary Mortars and Masonry Adhesives and Fillers: Perform work of this Section requiring proprietary patching materials and masonry adhesives and fillers only when surface and air temperatures are between 50 deg F and 85 deg F.
 - d. Hot-Weather Stone Masonry Restoration: Protect stone repair when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.
 - 1) Protect fresh mortar from premature drying when temperature, humidity, and wind conditions result in rapid drying of mortar. Provide and maintain tarps against wind, direct sun, and rain for specified minimum periods.

- 2) NHL-2 must be protected from drying for a minimum of two (2) weeks after installation. NHL 3.5 mortars must be protected from drying for a minimum of 72 hours after using mortar by the following procedure:
 - a) Water-soaked cover: Provide and maintain damp burlap or other damp cloths over masonry to protect mortars from premature drying. Install, maintain, and remove coverings using materials and methods that do not damage or alter masonry.
- e. Damage from Work in Cold or in Hot Weather: Remove work of this Section damaged by freezing during cold weather masonry work and/or damaged by premature or too-rapid drying during hot weather masonry work and replace with new masonry work complying with requirements of this Section at no additional cost to Owner.
- f. Requirements of Referenced Standard: Perform work of this Section in compliance with the requirements and recommendations of Brick Industry Association Technical Notes 1, *Cold and Hot Weather Construction*, Latest Edition.
2. Conflicting Requirements: In each case in which there is a conflict between manufacturer's recommendations, recommendations of referenced standards, and other requirements specified in this Section, the most stringent and restrictive requirement shall govern.
3. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.
4. Safety: Protect all persons, whether or not involved in work of this Section, from harm caused by or resulting from work of this Section.
 - a. Protection from Hazardous Materials: Protect workers and other persons from contact with hazardous materials resulting from work of this Section.
 - b. Protection from Noise: Limit noise generated by work of this Section to an absolute minimum. Prevent all persons, whether or not involved with the work of this Section, from noise that might adversely affect them.
5. Prevent mortar used in repointing repair work and injection grout from staining face of surrounding masonry and other surfaces. Remove immediately mortar in contact with exposed masonry and other surfaces.
6. Protect sills, ledges, and projections from mortar and sealant droppings.
7. Protection from Noise: Limit noise generated by work of this Section to an absolute minimum. Prevent all persons, whether or not involved with the work of this Section, from noise that might adversely affect them.

1.12 SEQUENCING AND SCHEDULING

- A. Order pointing mortar immediately after approval of mockups. Take delivery of and store at project site a sufficient quantity to complete Project.
- B. Work Sequence: Perform stone historic treatment work in the following sequence, which includes work specified in this and other Sections:
 1. Rake all mortar joints and repoint before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
 2. Rake out mortar from joints surrounding stone to be replaced and from joints adjacent to stone repairs along joints.
 3. Repair stonework.
 4. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source limitations: Obtain each type of material for repairing and repointing historic masonry (stone, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 STONE

- A. Stone Matching Existing: Provide natural building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with physical properties.
1. For existing stone that exhibits a range of colors, textures, grains, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches and individual color, texture, grain, veining, finish, size or shape within that range.
 2. Salvaged Limestone: Salvaged sound stone cleaned free of mortar, grout, dirt, and other contaminants and matching existing cleaned limestone in physical and chemical properties and in color, texture, and other surface characteristics.
 3. New Natural Dimension Stone
 - a. Source Limitations for Stone: Obtain stone from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
 - b. Natural Indiana Limestone:
 - 1) Material Standard: Comply with ASTM C 568.
 - a) Classification: II Medium-Density.
 - b) Smooth Finish.
 - c) Color: Buff to match existing stone.
 - d) Size: Match existing stone profiles and size to be replaced with new natural replacement stones.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces unfinished.
 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C216 and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide a blend of 50% existing salvaged brick and a 50% mixture of Yankee Hill Brick & Tile Medium Red Smooth and Yankee Hill Brick & Tile Dark Red Smooth or comparable products as manufactured by the following companies and approved by Architect prior to bidding.

The exact blend of bricks shall be determined by creating mockups per the requirements listed in this section.

- a. Acme Brick Company.
 - b. Glen-Gery Brick.
 - c. Belden Brick Company.
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 4. Size (Actual Dimensions): 3-5/8 inches wide by 2-3/8 inches high by 8 inches long.
 - a. Field verify existing brick dimensions to confirm sizes of required new bricks.
 5. Application: Use where brick is exposed unless otherwise indicated.
 6. Provide face brick matching color range, texture, and size of existing adjacent brickwork.

2.4 MORTAR GROUT AND MIXES

A. General

1. Mortars specified hereinafter shall comply with ASTM C 1713, Standard Specification for Mortars for the Repair of Historic Masonry.
2. Mix mortars using proportions specified herein as adjusted, if necessary, by the amount of moisture in the ingredients. The proportions specified are for dry cements and limes and damp, loose (saturated, surface-dry) sand. If ingredients with different moisture contents are used (for example, lime putty is used in place of lime or dry sand is used in place of damp, loose sand), adjust quantities so that the proportions of ingredients in the mixes equal the proportions specified as approved by Architect.

B. Mortar for Setting Dutchmen: Provide the following natural hydraulic lime mortar. Mortar mixes may change and may require adjustment before and during construction in accordance with pre-construction conformance testing, field testing, and Architect's evaluation of testing and test results.

1. Natural Hydraulic Lime to Match Adjacent Stone.
 - a. Natural hydraulic lime, NHL-5.

C. Custom Patching Mortar for Topping Fissures, Open Veins, Open Joints, and Losses Filled with Dispersed Hydraulic Lime Putty

1. 2 parts NHL-2 natural hydraulic lime.
2. 5 parts washed, sieved, and graded fine sand, combination of sands, or combination of sands and crushed marble selected to provide mortar with color matching color of adjacent marble with minimum addition of pigment.

D. Grout for Injecting Cracks – Dispersed hydrated lime with up to five percent water by weight. Mix with an electrically powered mixer for two to three minutes.

E. Grout for Natural Hydraulic Lime Injection Repairs: Mix by volume 7 parts natural hydraulic lime 5.0 with 3 parts water. Mix with an electrically powered mixer for two to three minutes.

2.5 MIXING OF MORTARS AND GROUTS

- ### A. Measuring: Measure mortar and grout ingredients carefully using containers with fixed volumes so that proportions are controlled and maintained throughout the work of this Section.

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- B. Mixing Lime Mortars and Grouts: Mix lime mortars and grouts using a helical paddle mixer, a pan mixer (in which the mortar is mixed by rotating paddles), or a traditional roller mixer as approved by lime supplier and Architect.
 - C. Water: Use minimum amount of water to produce a workable consistency for mortar's intended purpose.
 - 1. Mortar for Pointing: As dry a consistency as will produce a mortar sufficiently plastic to be worked into joints.
 - D. After mixing, mortars for pointing or setting shall sit for 20 minute prior to use to allow for initial shrinkage. Mortar shall be placed in final position within two hours of mixing. Retempering of partially hardened material is not permitted.
 - E. Mortar for grout shall be placed in final position within two hours of mixing or within period recommended by manufacturer of custom products, whichever is less. Retempering of partially hardened material is not permitted.
 - F. Custom Patching Mortars and Grouts: Mix in accordance with manufacturer's written instructions.

2.6 PRE-MIXED SETTING MORTAR

- A. Portland Cement: ASTM C150/C150M, Type I or Type II; white or gray, where required for color matching of mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C207, Type S
- C. Mortar Sand: ASTM C144 unless otherwise indicated.
 - 1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
 - 2. Colored Mortar: Provide natural sand or other sound stone of color necessary to produce required mortar color.
 - 3. For exposed mortar, provide sand with rounded edges.
- D. Water: Potable

2.7 HISTORIC POINTING MORTAR

- A. A custom factory mixed Historic Pointing Mortar to be formulated for tuck-pointing limestone and brick, which shall match existing mortar in color, texture, and mix.
 - 1. Product: Subject to compliance with requirements, provide one of the following:
 - a. Cathedral Stone; Jahn M110 JL Historic Pointing Mortar.
 - b. Conproco; RePoint.

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2. Any additional mortar samples that may be required shall be taken from selected areas as directed by Architect and sent to pointing mortar manufacturer for custom color matching and mortar proportions
- B. Surface Preparation: Joints to receive pointing mortar must be sound and free of all dust, dirt, grease, laitance, and/or any other coating or foreign substance which may prevent proper adhesion. Remove all loose and deteriorated mortar. The minimum depth of mortar application is 1-1/2 times the width of the mortar joint or 1 inch, whichever is greater. Rinse joints with clean water.
 - C. Mixing: The mixing ratio is approximately 4 to 5 parts replication mix to 1 part water by volume, depending on temperature and humidity. Place clean water in a clean, rust free mixing container and add the powder. Mix manually until the mortar is thoroughly mixed. The mortar shall be the consistency of damp sand. Follow manufacturer's recommendation.
 1. Add aggregate as required to match the color and texture of the existing mortar. Do not exceed the allowable ratio mix of aggregate to mortar per the manufacturer's requirements. Adding mineral pigments is not allowed for this project. Color and texture shall be adjusted using aggregates to the replication mix
 - D. Pointing: Moisten the joint using clean water. If the surface is allowed to dry out before applying pointing mortar, this step must be repeated. The mortar shall be applied using appropriate pointing tools. Place the mortar into the joint so that it matches the original joint profile.
 - E. Curing: Periodically mist mortar joints using clean water for at least a 72 hour period.
 - F. Clean Up: Remove uncured mortar from the substrate before it dries using clean water and a rubber sponge. Cured mortar may only be removed chemically.
 - G. Safety Requirements: It is recommended that safety goggles, gloves, and a dusk mask equipped with P-2 filters (or Equivalent) be worn for protection when mixing.
 - H. Limitations:
 1. Never apply pointing mortar to a frosted or exceedingly hot substrate. The applied mortar must be protected from extreme heat, freezing, excessive wind, direct sunlight, and rain. Ambient temperature range shall be 40 deg. F to 90 deg. F with low to average humidity.
 2. Never add bonding agents to pointing mortar or use them as surface preparation materials.
 3. Minimum thickness of mortar application is 1" or 1-1/2 times the existing mortar width, whichever is greater.
- 2.8 MANUFACTURED REPAIR MATERIALS
- A. Patching Mortar for Limestone: Factor-mixed cementitious product that is custom manufactured for patching stone.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cathedral Stone Products, Inc.; Jahn M70
 - b. Conproco; Matrix Super Fine
 2. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all stone types.
 3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.

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4. Formulate patching mortar in colors, textures, and grain to match stone being patched. Provide no fewer than three colors to enable matching each piece of stone.
 - B. Cementitious Injection Grout: An ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all stone types.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cathedral Stone Products, Inc.; Jahn M40 Crack Injection Grout.
 - b. Edison Coatings, Inc.; Pump-x 53i
 - c. Conproco; Injection Grout
 - C. Masonry Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15-to-45-minute cure at 70 deg. F (21 deg. C), recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Cathedral Stone Products, Inc.; Natural Adhesive
 - b. Edison Coatings, Inc.; Pump-x53i
 - c. Conproco; Injection Grout
 - D. Dispersed Hydrated Lime: Non-hydraulic dispersed hydrated lime (DHL) for use in injecting narrow cracks. Provide non-hydraulic Dispersed Hydrated Lime (DHL), (U.S. Heritage Group, 3516 North Kostner Avenue, Chicago, IL 60641 (773-286-2100).
 - E. Dispersed Hydrated Lime Injection Mortar for Wide Cracks: Non-hydraulic dispersed hydrated lime putty consisting of dispersed hydrated lime, marble powders, and dispersing aids for use in injecting cracks up to 1/8-inch wide. (U.S. Heritage Group, 3516 North Kostner Avenue, Chicago, IL 60641 (773-286-2100).

2.9 VOID INJECTION GROUT

- A. Void Injection Grout: Suitable for application to wet or dry joints, exhibits low shrinkage, and develops high bond strength to all types of stone. No polymers, acrylics, or epoxies will be accepted in the final material. Grout injection material shall be non-chloride and non-corrosive. Injection material shall match the properties of the host, including vapor transmissions and compressive strength.
 1. Mix Design: One part Portland cement, one part lime; six (6) parts silica sand. Sieve size of minus 30 to achieve a fine viscosity and pumpable mix, and shall meet requirements of ASTM 476.

2.10 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 316, 0.016 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 - a. Solder metal items at corners
- B. Flexible Flashing: Use one of the following unless otherwise indicated:

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1. Copper-Laminated Flashing: Provide metal flashing complying with ASTM B370. Use 5-oz./sq. f. for thru-wall flashing, copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advanced Building Products Inc.; Copper Sealtite 2000.
 - 2) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing NA.
 - 3) York Manufacturing, Inc.; Multi-Flash 500.
 - C. Application: Unless otherwise indicated, use the following:
 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond wall face, use flexible flashing with a stainless steel drip edge.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use flexible flashing with a stainless steel drip edge.
 4. Where flashing is fully concealed, use flexible flashing.
 - D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard product or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
 - E. Termination Bars for Flexible Flashing: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8 inch sealant flange at top.
- 2.11 CLEANING MATERIALS AND EQUIPMENT
- A. Masonry Cleaner: Refer to PART 3 – EXECUTION for masonry cleaner products and solutions to be applied to stone and brick areas.
 - B. Water for Cleaning: Clean, potable, free of oils, acids, alkalis, salts, and organic matter.
 - C. Brushes: Fiber bristle only.
 - D. Spray Equipment: Provide equipment for controlled spray application of water and chemical cleaners, if any, at rates indicated for pressure, measured at spray tip, and for volume.
 1. For spray application of chemical cleaners, provide low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray-tip.
 2. For spray application of water, provide fan-shaped spray-tip which disperses water at angle of not less than 45 degrees.
 - E. Mild Acidic Cleaner for Pointed Joints: Manufacturer's standard mildly acidic cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
 1. Products: Subject to compliance with requirements, provide basis of design:
 - a. Prosoco Vana Trol or approved equal.
 - b. All newly pointed joints shall be 100% cleaned.
- 2.12 ACCESSORY MATERIALS
- A. Masonry Anchors and Pins: Type and size indicated. Fabricate anchors and pins from Type 316 stainless steel.

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- B. Setting Buttons and Shims: Resilient plastic, non-staining to stone, sized to suite joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.
- C. Masking Tape: Non-staining, non-absorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.
- D. Weep/Vent Products: Use one of the following unless otherwise indicated:
1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, ¼ or 3/8 inch in diameter, in length required to product 1/2-inch exposure on exterior and 12 inches in cavity. Use only for weeps where indicated on drawings.
 2. Cell Vent.
- E. Micro-Pins: Orthopedic surgical bone screws of ASTM A 276 or ASTM A 666 Type 316 stainless steel or titanium (grade 2), 4 mm diameter, head no larger than 6 mm diameter with a recessed hex mortise (Diverse Surgical Supply, 7033 N. Fresno Street, Fresno, CA 93720 (866-800-9414) (or approved equal).
- F. Temporary Crack Sealer: Two-component, non-sag, polyurea paste designed for sealing surfaces of cracks and delaminations in masonry to allow pressure injection of adhesives and grouts. Test crack sealer to ensure that it can be removed without damaging or staining stone. (StripSEAL™ manufactured by ChemCo Systems, 2800 Bay Road, Redwood City, CA 94063 or approved equal).
- G. Sealants for Pointing Joints in Stone and Brick: Manufacturer's standard chemically curing, elastomeric sealants of base polymer that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain masonry.
- H. Syringe for Injection of Dispersed Hydrated Lime:
1. Syringe with 12 gage stainless steel needle.
 2. Plastic Injection Syringes Manufacturer: Cathedral Stone Products, Inc. or approved equal.
- I. Air Compressor and Related Equipment: Air compressor, hoses, nozzles, valves, oil and water filters, storage tank, and accessories as necessary to provide clean, oil- and water-free, filtered compressed air at a pressure of 100 psi and a flow rate of 6 cfm. Maintain equipment in optimum condition to ensure that clean, dry, oil-free air is consistently available at required pressure and flow rate.
- J. Brushes for Cleaning Anchor Holes: Stiff wire bristle or nylon bristle brushes of diameter to ensure full cleaning of dust and debris from masonry substrate at sides and bottom of hole. Furnish brushes specifically manufactured for cleaning anchor holes in masonry substrates. Brushes shall be sized appropriately for holes in which they are to be used so that they firmly contact entire circumference of hole at the same time. Use sizes recommended by anchor manufacturer and approved by Architect. (Hilti, Inc., PO Box 21148, Tulsa, OK 74121 (800-879-8000), Powers Fasteners, Inc., 2 Powers Lane, Brewster, NY 10509 (914-235-6300), Simpson Strong-Tie, 26 International Street, Columbus, OH 43228 (614-876-8060), or approved equal).
- K. Brushes for Cleaning Cracks and Losses: Stiff nylon bristle brushes of shape and dimension to provide optimum removal of contaminants from stone surface and approved by Architect.
- L. Air Nozzle for Cleaning Anchor Holes: Nozzle specifically manufactured and sold for use in removing dirt and debris loosened by use of brushes in anchor holes and of length capable of reaching bottom of deepest anchor holes so that debris is blown free from bottom of holes

outward. Provide 24-inch-long air nozzle by Hilti, Inc., PO Box 21148, Tulsa, OK 74121 (800-879-8000), or approved equal.

- M. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
1. Previous effectiveness in performing work involved.
 2. Minimal possibility of damaging exposed surfaces.
 3. Consistency of each application.
 4. Uniformity of the resulting overall appearance.
 5. Do not use products or tools that could do the following:
 - a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
 - b. Leave residue on surfaces.

2.13 TOOLS FOR JOINT PREPARATION

- A. Hand Tools for Joint Preparation: Chisels, hammers, and mallets.
1. Thickness of Chisels: Maximum thickness of 5/8 times joint width extending from tip at least three times depth at which chisel will be inserted into joint;
 - a. Chisels for Use in Narrow Joints: Use custom ground thin carbide- tipped chisels for mortar removal from narrow joints.
 2. Brushes for Removing Dust and Dirt from Joints: Stiff, natural- or synthetic-fiber bristle brushes. No metal bristle brushes are acceptable.
 3. Pointing Trowels: Long, thin pointing trowels narrower than joints being pointed.
 - a. Custom fabricate special trowels for masonry pointing if necessary to ensure proper insertion and optimum compaction of mortar in thin joints.
 4. Special Tools: Provide special knives or special thin cutter blades for use in joints less than 1/8-inch wide.
- B. Small Power Tool:
1. If successful use of the power tool is reviewed and approved by Architect, contractor may use the following tool for removal of the existing mortar joints:
 - a. The custom-made, 22-milimeter diameter, 1/8-inch thick, diamond tipped Dremel blades specially produce by Wagner Precision Rotary Instruments, LLC or approved equal.

PART 3 - EXECUTION

3.1 GENERAL PREPARATION

- A. Comply with recommendations of manufacturers of chemical cleaners for protecting building surfaces against damage from exposure to their products.
- B. Examination: Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of work. Do not proceed until unsatisfactory conditions have been corrected.
- C. Protection: Erect dust impervious barriers and take other measures necessary to prevent dust from traveling beyond work platform before using power grinders, or hand methods that generate airborne dust.

3.2 PROTECTION

- A. Protection: Erect dust impervious barriers and take other measures necessary to prevent dust from traveling beyond work platform before using power grinders, or hand methods that generate airborne dust.
- B. Protect persons, motor vehicles, surrounding surfaces of building whose masonry surfaces are being restored, building site, and surrounding buildings from injury resulting from masonry restoration work
 - 1. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings and other surfaces which could be injured by such contact.
 - 2. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
 - 3. Dispose of run-off from cleaning operations by legal means and in manner which prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
 - 4. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles which must remain in operation during course of masonry restoration work.
- C. Protect glass and unpainted metal from contact with acidic chemical cleaners by covering them with protective film. Apply protective film to comply with manufacturer's recommendations.
- D. Protect unpainted metal from contact with alkali chemical cleaners by covering them with polyethylene protective film and waterproof masking tape.
- E. Containment of all run-off related to cleaning masonry will be a must in order to minimize impact on surrounding vegetation; contractor is responsible to meet all local, state and federal regulations in each masonry cleaner application, handling, and disposal.
- F. Prevent mortar from staining face of surrounding stone and other surfaces.
 - 1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
 - 2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
 - 3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

3.3 STONE REPAIR, GENERAL

- A. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 3 feet away by Architect.

3.4 STONE DUTCHMAN REPAIR

- A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair or is to be reused. Carefully remove portion of damaged stone without damaging surrounding masonry, in a manner that permits replacement.
- B. Support and protect remaining masonry that was supported by removed stone.

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- C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.
 - D. Remove in an undamaged condition as many whole stone units as possible.
 - 1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
 - E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.
 - F. Replace removed damaged stone with other removed stone and salvaged stone in good condition, where possible, or with new stone matching existing stone. Do not use broken units unless they can be cut to usable size.
 - G. Dutchman Preparation: Dress stone dutchman on all sides and carefully fit to opening in stone, with an allowance of not more than 1/16-inch-wide buttered joints at face. Dress surface of dutchman to match appearance, tooling, and texture of adjacent stone using an approved method. Complete surface dressing of dutchman before installing dutchman.
 - H. Cleaning Anchor Holes and Substrate: Use stiff bristle brushes and filtered, oil-free compressed air to thoroughly remove dust and debris from anchor holes and from stone surfaces to receive mortar.
 - I. Wetting Stone Surfaces: Wet surfaces to receive mortar to ensure that surfaces are damp but free of standing water at time of mortar application (saturated, surface dry).
 - J. Rift: Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, the rift or natural bedding planes are predominantly horizontal. Reject stone with vertical bedding planes.
 - K. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.
 - 1. Maintain joint width for replacement stone to match existing joints.
 - 2. Use setting buttons or shims to set stone accurately spaced with uniform joints.
 - L. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated.
 - 1. Rake out mortar used for laying stone before mortar sets. Point at same time as repointing of surrounding area.
 - 2. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.
 - M. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
 - N. Metal attachments for setting stone Dutchman:
 - 1. All wire, pins, anchors, and bars shall be stainless steel, Type 316.
 - 2. Provide anchors as follows:

- a. 1/8" diameter round stock, stainless steel wire with turned-up ends for small veneers.
 - b. 1/4" or 3/8" diameter round stock, stainless steel rod for direct pinning and drop dowels.
 - c. 1" wide, 1/8" thick, stainless steel, flat strap anchors for larger panels.
3. The quality of individual attachments shall not be less than two attachments for small Dutchman, and one attachment every two square feet for larger panels. Fasten dutchman with stainless steel wire, pins, and anchors as necessary to provide mechanical locking and to prevent possible slippage of stone. Position metal anchors without weakening stone in any way.
 4. All attachments shall be fastened by mechanical locking, in addition to appropriate adhesives and mortars.
- O. Adhesives for attaching anchors and for direct pinning: Where permitted, anchors may be held in place with high modulus, high strength, moisture insensitive, epoxy adhesive. Adhesive shall be two-component 100% solids, epoxy resin system with a viscosity similar to petroleum jelly "Sikadur 31 Hi-Mod Gel" (Sika corporation), or approval equal.

3.5 STONE REPAIR

- A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.
- B. Remove soil, loose particles, mortar, and other debris or foreign material, from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.
- C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone. Center and space pins 3 to 5 inches (75 to 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in parent stone and 2 inches (50 mm) in fragment with end countersunk at least 3/4 inch (19 mm) from exposed face of fragment
- D. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.
- E. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.
- F. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes.

3.6 CRACK INJECTION FOR STONE

- A. Preparation for Grouting Cracks: Drill 1/8-inch-diameter injection ports into each crack approximately 6 inches on center. Remove dust, dirt, loose particles, and other contaminants that might adversely affect adhesion of grout or durability of grout from crack using mechanical means followed by clean, oil-free compressed air. Protect adjacent masonry surfaces from contact with grout using approved methods.

- B. Prewetting Substrates: Immediately before injecting grout, flush crack with clean water. If grout is not installed immediately, flush crack again with water to ensure that stone surfaces at sides of crack are wet at time of grout injection.
- C. Grout Injection: Inject cementitious grout using gravity flow or other approved equipment and methods to ensure that crack is filled as approved by Architect.
- D. Application of Patching Mortar to Injection Ports: Fill holes with specified patching mortar matching color of adjacent cleaned stone.
- E. Finishing: Strike surface flush with face of adjacent stone.
- F. Curing: Protect grout and mortar from too rapid drying and from contact with water that might wash binder from surface.

3.7 STONE PATCHING

- A. Removal of Material
 1. Remove to Sound Stone: Remove deteriorated stone to minimum depth necessary to reach sound material or substrate. Remove sound material to a depth of at least 1/2 inch behind finished surface of patch to provide for a minimum patch depth of 1/2 inch. Do not damage or disturb sound masonry further than 1/2 inch below the surface. Do not chip edges of masonry units.
 2. Edges: Cut edges of areas where stone has been removed straight and parallel or perpendicular to joints in façade.
 3. Dovetail Mechanical Bond: Where surface of damaged stone is greater than 1/2 inch behind plane of adjacent block, slightly undercut edges of area to be patched to provide a slight dovetail.
- B. Additional Mechanical Bond for Patches over 2 Inches Deep: Where the surface of sound stone is more than 2 inches below plane of facade, provide threaded rod anchors for mechanical bond of patching mortar.
 1. Drilling Anchor Holes: Drill holes 1 inch deep by 1/8 inch larger in diameter than threaded rods, 2 inches on center horizontally and vertically. Drill holes at slightly varying angles within 10 degrees of perpendicular to façade plane.
 2. Cleaning Anchor Holes: Clean anchor holes using stiff bristle brushes as recommended by adhesive manufacturer followed by blowing with clean, oil-free compressed air.
 3. Installing Threaded Rods: Anchor threaded rods in holes using epoxy adhesive. Rods should extend to a point 1 inch behind finished surface of patch.
- C. Preparation
 1. Cleaning: Clean surfaces to be patched and filled so that they are free from dust, dirt, oils, grease, and other substances and coatings that might adversely affect adhesion of filling and patching material. Brush surfaces with stiff fiber-bristle brushes and blow clean with clean, oil-free compressed air to make certain that loose materials have been removed. Wash surfaces of prepared stone with clean water and specified detergent. Rinse thoroughly with clean, clear water and soft, natural fiber bristle brushes.
 2. Wetting: Wet surface of prepared stone with clean water and soft fiber-bristle brushes to ensure that at time of patching vertical surfaces are glistening wet and horizontal surfaces are dampened without pooling water. If surfaces dry out before applying cementitious patching mortar, repeat the wetting process.

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- D. Application of Patching Mortar: Prepare and apply patching mortar in strict accordance with manufacturer's directions.
1. Application of "Peanut Butter" Coat: Apply patching mortar mixed with water to the consistency of wet putty to the wet substrate to a thickness of approximately 1/8 inch. Do not allow "Peanut Butter" coat to dry out before applying patching mortar of standard consistency with water content as recommended by manufacturer.
 2. Application of Patching Material: Apply patching mortar to fill voids. Trowel mortar onto wet "peanut butter" coat. Fill entire void in one steady lift, building material up slightly beyond the plane of the adjacent surfaces. Compress material as it is installed to ensure entire void is filled without gaps.
- E. Finishing: After initial set (dependent on wind, temperature, and humidity) scrape away excess mortar to provide the appropriate profile matching adjacent planes and profiles. Finish surface to match adjacent surface.
- F. Curing: Periodically mist cementitious patching mortar gently using clean water at intervals determined in accordance with the manufacturer's written instructions but at least several times a day for a period of at least 72 hours following installation. Begin misting at appropriate time depending on temperature, humidity, and wind conditions as recommended by manufacturer. Should access to the repairs be impossible over a period of time, plastic may be used to cover them temporarily. The application of plastic, however, does not remove the need for normal curing techniques.
- 3.8 SECURING DETACHED SECTIONS OF STONE UNITS USING MICRO-PINS, PATCHING HOLES FOR PINS, AND GROUTING CRACKS
- A. General: Secure displaced and cracked stone by drilling holes and inserting thin stainless steel or titanium screws in locations indicated on Drawings. Grout cracks with cementitious grout to match color of adjacent cleaned stone surface.
- B. Spacing and Number of Screws: Install screws at spacing indicated on Drawings.
1. Minimum Spacing
 - a. Multiple Screws: Install multiple screws at least 6 times screw diameter apart.
 - b. Edge Clearance: Do not install screws less than 4 times screw diameter from the edge of stone unit or piece of unit.
- C. Drilling for Screws: Drill holes using a rotary drill with a masonry bit. A bit designed for glass or ceramic may be used to drill a starter hole. Drill 1/8-inch- or 9/16-inch-diameter holes for 4-mm-diameter screws, depending on the stone's hardness as determined by testing to determine most appropriate hole size for screw attachment. Drill a 1/4-inch-diameter hole 1/2 inch deep to countersink screw head.
- D. Depth of Screw: Provide for insertion so that screw will extend into sound substrate at least 4 times the diameter of the screw and will extend into the section of loose stone at least 4 times the diameter of the screw.
- E. Inserting Screws: Insert screws by hand using a hex key. Do not use a power tool. During insertion, back screws out and remove stone debris from screws and holes as often as necessary to ensure complete insertion.

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- 3.9 FILLING VEINS AND CRACKS IN LIMESTONE WITH DISPERSED HYDRATED LIME AND NATURAL HYDRAULIC LIME TOPCOAT
- A. General: Fill open veins as indicated on drawings using dispersed hydrated lime as specified herein. Protect fills in veins with pigmented topcoat of natural hydraulic lime mortar. Work shall match approved mock-up.
 - B. Preparation of Open Veins: Clean all open veins free of dirt and debris using clean, oil-free compressed air. Flush veins with nonionic detergent (1% solution in distilled water) to remove residual dust and soiling. Allow to dry to condition recommended by manufacturer of dispersed hydrated lime. Seal surface with custom mixed NHL-2 lime putty as described in subparagraph "Protective Coating for Veins," below.
 - C. Dispersed Hydrated Lime Fill: Inject vein with dispersed hydrated lime injection mixture or dispersed hydrated lime injection mortar, depending on the width of the crack, using specified syringe.
 - 1. Vertical Cracks: Start at bottom of crack and inject until crack will not take any more material. Inject at higher locations along crack until crack is full.
 - 2. Horizontal Cracks: Start at one end of crack and inject until crack will not take any more material. Inject at further locations along crack until crack is full.
 - D. Protective Coating for Veins: Top fill veins with custom-mixed NHL-2 lime putty. Mix lime and water following manufacturer's recommended proportions and procedures to produce a putty of suitable workability. Add mineral pigments as needed to assure accurate color-match with cleaned stones. Lightly mist areas to be filled before application. Carefully fill cracks to meet adjacent stone surfaces. Press marble dust into surface during modeling. Maintain damp protection and allow to set at least 12 hours. Protect fills from premature drying from sun or wind and mist as needed to assure complete cure. Maintain protection and mist to keep damp for a minimum 2 weeks after installation.
- 3.10 STONE-WASTE DISPOSAL
- A. Salvageable Materials: Unless otherwise indicated, excess stone materials are Contractor's property.
 - B. Stone Waste: Remove stone waste and legally dispose of off Owner's property.
- 3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS
- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
 - B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.

3. At lintels and shelf angles, extend flashing 8 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 8 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
 4. Install stainless steel drip edges with fabric flashing by interlocking hemmed edges to form hooked seam.
 5. Install all thru-wall and under coping flashings with positive slope to allow water to drain out, and avoid any ponding of water over flashings.
- C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Space weep holes formed from wicking material 16 inches o.c.
 2. Trim wicking material flush with outside face of wall after mortar has set.

3.12 BRICK REMOVAL

- A. Carefully remove by hand at locations indicated any brick which are damaged, spalled, or deteriorated due to construction activities, including shoring and bracing of the existing building envelope. Cut out full units from joint to joint and in manner to permit replacement with full size units. Small hand power saw (3"-4" diameter) with 1/8" thick diamond blade only could be used for bed joints. Cut out head joints by hand with chisel and mallet only.
- B. Support and protect masonry indicated to remain which surround removal area.
- C. Salvage as many whole, undamaged bricks as possible.
- D. Remove mortar, loose particles, and soil from salvaged brick by cleaning with brushes and water. Store brick for reuse.
- E. Clean remaining brick at edges of removal areas by removing mortar, dust, and loose debris in preparation of rebuilding.
- F. Repair any damaged flashing to make watertight.

3.13 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.

3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

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

3.14 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in common bond matching existing brick; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches . Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.15 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- B. Adjustable Anchors for Connecting to Masonry: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Stainless Steel Corrugated Buck Anchor.
 - a. Basis-of-Design Product: Provide 345 Corrugated Buck Anchor, Stainless steel, 14 gauge or approved equal from:
 - 1) Wire-Bond
 - 2) Heckmann Building Products

3.16 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry or offset angle support lintels where indicated and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.17 JOINT PREPARATION FOR JOINTS CONTAINING MORTAR

- A. General: Remove mortar from joints to a depth of 1 inch, 1-1/2 times the width of the joint, or to sound mortar, whichever is deepest. In all cases remove deteriorated, weathered, and loose material to sound mortar.
- B. Completely remove mortar from surfaces of masonry units adjoining joint to allow new mortar to bond directly with masonry units.
- C. Cut surface of mortar at rear of joint at a uniform depth from and parallel to wall surface.
- D. Do not damage faces or arises of masonry units during joint preparation. Cease joint preparation work if, in Architect's judgment, masonry units are damaged by methods being used to prepare joints. Do not resume work until tools, workers, and methodology have been corrected to ensure that masonry units are not damaged and that work meets standard set by approved mock-up.
- E. Mortar Removal Using Hand Tools: Use hand tools for removal of mortar from head joints in brickwork, from other joints in stone and brick masonry that are less than 6 inches long, and from other joints in which use of power tools might damage masonry units. Use hand tools to complete mortar removal from joints where power tools have been used to partially remove mortar.
- F. For narrow joints of 1/8-inch or less in width, rake mortar from joints manually with a sharp knife blade or cutter made for this purpose. Cutter may be used with or without aid of a hammer.

- G. Sharpen chisels as often as necessary to provide for optimum cutting of mortar and to minimize chipping but at least hourly.
- H. Cleaning: Remove loose mortar and foreign material from raked joints using a fine, stiff natural- or synthetic-fiber bristle brush. Remove remaining particles, dust, and dirt using clean, filtered, oil-free compressed air. Ensure that dust and dirt are not blown back into previously cleaned joints.

3.18 MORTAR APPLICATION

- A. Wetting: Thoroughly drench masonry with water 24 hours prior to pointing joints. Thoroughly wet masonry again immediately before pointing joints and allow surfaces to dry slightly. At time of masonry pointing, surfaces shall be damp, so that they do not rapidly absorb moisture, but free of standing water (saturated, surface dry).
 - 1. Failure to Properly Wet Substrate: Evidence that masonry to be pointed has not been properly dampened to prevent water in the mortar from being too rapidly absorbed by the masonry will be cause for Architect to reject pointing work. Remove rejected pointing, properly prepare joints for pointing, and provide new mortar to meet requirements of this Section at no additional cost to Owner.
- B. Masonry Pointing: Point joints as follows:
 - 1. Using a long, thin masonry pointing trowel, apply pointing mortar to a dampened surface, packing the mortar into the joint to ensure full depth compaction. The mortar should be brought flush with the face of the masonry unit, and left to set for final tooling. Pointing mortar can be applied in a single lift regardless of the depth. Successive lifts with waiting periods between lifts are not necessary.
 - 2. Do not spread mortar over edges onto exposed surfaces of masonry units. Do not featheredge mortar.
 - 3. When stopping work at end of each day or for other reasons, stagger layers of mortar so that there will be no through joints in mortar inserted into joints. Stagger joints in layers so that they are at least 3 inches from each other.
 - 4. Where applying new work to that of a prior day, dampen previous work to ensure good bond.

3.19 JOINT TOOLING

- A. Profile: After mortar joint has "set", tool joints to profile to match original joint profiles as directed by Architect. Solidly compress mortar so that it adheres well to masonry on both sides and forms a dense surface. Premature or late tooling will result in unacceptable finishes, which will be rejected.

3.20 CURING

- A. Keep newly pointed joints damp for at least 72 hours after mortar has been inserted. Do not apply a direct stream of water to joints for at least 7 days after mortar has been placed.
- B. Ensure masonry temperature remains as required by specifications until mortar is thoroughly cured.

3.21 CLEANING AND REPAIR OF MORTAR JOINTS

- A. Water Washing: Wash pointed masonry with clean filtered water, mild acidic cleaner, and nonabrasive hand tools to remove mortar debris from masonry surfaces. Do not use chemical cleaners.
1. Wash within 72 hours after completion of masonry pointing.
 2. Use blunt-edged wood scrapers, soft natural bristle brushes, and rough towels along with water to remove mortar debris. Do not use wire brushes. Do not scratch joint surfaces.
 3. Do not allow pointing mortar beyond the face of the masonry unit. All edges of masonry shall remain visible.
- B. Repair of Pointed Joints: As cleaning progresses, examine joints to locate cracks, holes, and other defects. Carefully point up and fill such defects with mortar. Where joints are defective in opinion of Architect cut out joints to minimum depth of 1 inch, or two-and-one-half times joint width, whichever is greater; properly prepare joint substrates; and provide new pointing mortar exercising extreme care to ensure that color matches that of adjacent masonry pointing work. Exposed joint surfaces shall be free from protruding mortar, holes, pits, depressions, and other defects.

3.22 CORRECTIVE MEASURES

- A. Correcting Unacceptable Joints: Should a crack occur in any joint surface, should mortar separate from a masonry unit, indicating that it did not form a strong mechanical and chemical bond with the unit, or should Architect determine that for another reason masonry pointing work does not equal or exceed the minimum standard established by the approved mock-up, remove mortar to a minimum depth of 1 inch, properly prepare joint substrates, and repoint following requirements of this Section to Architect's satisfaction at no additional cost. At completion of work of this Section, joints shall be full of mortar soundly adhered to surfaces of masonry units at sides of joints and without defects.

3.23 INSTALLATION OF JOINT SEALANTS

- A. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than 1 inch. Rake joints to uniform depths with square bottoms and clean sides. Rub masonry sand to fresh sealant joint to simulate adjacent mortar joint appearance.
- B. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants".
- C. Remove excess sealant and smears as sealant is installed.

3.24 CLEANING STONE WORK

- A. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.
- B. Limestone Cleaner: Severe Soiling and Algae Growth Cleaner:
1. Refer to drawings for stone surfaces to receive this method of cleaning.
 - a. Step One: Apply mix for 5-gallons of following solution to dry surface

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- 3 gallons clean water
 - 1 gallon of ReKlaim Cleaner, manufactured by ProSoCo, Inc.
 - 1 gallon of ReKlaim Activator, manufactured by ProSoCo, Inc.
 - b. Step Two: Allow about 10 to 20 minutes for mix to work on the soil. If solution begins to dry, reapply
 - c. Step Three: Gently scrub heavily soiled areas
 - d. Step Four: Rinse thoroughly with clean water. If using a sponge or string mop to rinse, change rinse water often. Pressure-rinse porous surfaces to remove heavy soiling.
 - e. Step Five: Immediately after rinsing, apply the following mix of Limestone & Masonry Afterwash to the wet surface:
 - 1-part clean water.
 - 1-part Sure Klean Limestone & Masonry Afterwash, manufactured by ProSoCo Inc.
 - f. Let the Afterwash stay on the surface for 3 to 5 minutes.
 - g. Pressure rinse from the bottom of the treated area to the top. Make sure to cover each portion of the masonry surface with a concentrated stream of water. To avoid streaking, keep wall surfaces immediately below area being cleaned wet and free of cleaner rundown and residues.
2. Note: After severe soiling and algae growth has been cleaned from areas called out on the drawings, use cleaning method for Limestone general cleaning application.
- C. Limestone Cleaner - Soil and Weathering Cleaning:
- 1. This method shall be used on all stone surfaces of Jesse Auditorium.
 - a. Step One: Apply ReVive, by ProSoCo, Inc. to dry surface until surface is thoroughly wet.
 - Refer to manufacturer's Dilution & Mixing rates for cleaning solution
 - b. Step Two: Leave on surface for 2 to 3 minutes. If needed, apply more to keep surface wet.
 - c. Step Three: Mist treated surfaces with water and gently scrub with a non-metallic, short-fibered scrub brush to loosen biological soiling.
 - d. Step Four: Working from the bottom to the top, rinse thoroughly with clean water. Reduce rinsing pressure as needed for fragile or deteriorated stone.
- D. General:
- 1. The Contractor shall provide access to the entire building exterior for cleaning operations. This may involve multiple types of staging, scaffolding, etc. for access to various areas.
 - 2. Proceed with cleaning in an orderly manner; Work from top to bottom of each scaffold width and from one end of each elevation to the other.
 - 3. Use only those cleaning methods indicated for each stone material and location.
 - a. Use natural-fiber brushes only.
 - b. Use spray equipment that provides controlled application at volume and pressure indicated and measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage stonework.
 - c. Equipment units with pressure gages.
 - d. For water saturation spray application, use a fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees. Position tips with 6" to 8" from soiled surfaces. Use 45-degree nozzles for power washing.
 - e. Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, moldings, interstices, and that produces an even effect without streaking or damaging stone surfaces.
 - f. Pre-wet all surfaces to be cleaned with ionized water to avoid streaking.

3.25 BRICK CLEANING

- A. This method shall be used on all brick surfaces at Jesse Auditorium.
- B. Pre-wet the masonry surface with clean water.
- C. Mix one part clean water with one part 800 Stain Remover.
- D. Apply the mix directly to the masonry surface with recommended masonry brush or low-pressure spray. Pressure spray above 50 psi drives the chemicals deep into the surface, making complete rinse difficult.
- E. Let the cleaner stay on the surface for 3-5 minutes. Gently scrub with a non-metallic, short-fibered scrub brush to loosen the stains or until stains are gone. If treated surfaces are left unattended, keep people away from cleaner. Don't let the cleaner dry on the surface. If the cleaner begins to dry in less than 5 minutes, water rinse and reapply cleaner.
- F. Reapply cleaner and rinse with fresh water. Thorough rinsing gets all residues off the surface. The best combination of rinsing pressure and water volume is provided by masonry washing equipment generating 400-1000 psi with a water flow rate of 6-8 gallons per minute delivered through a 40 degree fan spray tip. Equipment should be adjustable to reduce water flow rate and rinsing pressure as required for controlled cleaning of more sensitive surfaces. Avoid multiple applications.
- G. Test a minimum 4 ft. by 4 ft. area on each type of masonry. Use manufacturer's application instructions. Let the test panel dry 3 to 7 days before inspection. Keep test panels available for comparison throughout the cleaning project.

3.26 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
 - 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.
- B. Clean adjacent non-stone surfaces. Use detergent and soft brushes or cloths.
- C. Remove masking materials, leaving no residues that could trap dirt.
- D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

END OF SECTION 045000

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
- B. Related Sections include the following:
 - 1. Division 9 painting Sections for surface preparation and priming requirements.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
 - 1. Design connections using AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.
- B. Construction: Type PR, partially restrained.
- C. Construction: Type 2, simple framing.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. For structural-steel connections indicated to comply with design loads, include structural analysis data prepared by the qualified professional engineer responsible for their preparation.

- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Comply with applicable provisions of the following specifications and documents:
 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 5. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 572/A 572M, Grade 50.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: Plain.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type, plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Hooked.
 - 2. Nuts: ASTM A 563 heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 hardened carbon steel.
 - 5. Finish: Plain.
- E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 hardened carbon steel.
 - 4. Finish: Plain.
- F. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 heavy hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

- C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.

- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.

- B. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils .

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
 - 1. Fill vent holes and grind smooth after galvanizing.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.

- b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
- 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION 051200

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
- B. Related Sections include the following:
 - 1. Division 9 painting Sections for repair painting of primed deck.

1.2 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- C. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Deck:
 - a. ASC Profiles, Inc.
 - b. Consolidated Systems, Inc.
 - c. DACS, Inc.
 - d. Epic Metals Corporation.
 - e. Marlyn Steel Decks, Inc.
 - f. Nucor Corp.; Vulcraft Division.
 - g. Roof Deck, Inc.
 - h. United Steel Deck, Inc.
 - i. Verco Manufacturing Co.
 - j. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 - 2. Deck Profile: As indicated on drawings.
 - 3. Profile Depth: As indicated on drawings.
 - 4. Design Uncoated-Steel Thickness: As indicated on drawings.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.

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2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 18 inches apart, maximum.
 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
 - D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
 - E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
 - F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof rafter framing.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes and connections used with cold-formed metal framing.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cold-formed steel framing materials.
 - 2. Roof-rafter framing.
 - 3. Post-installed anchors.
 - 4. Power-actuated anchors.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and ASTM C955.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
1. Grade: ST50H (ST340H).
 2. Coating: G90 (Z275) or equivalent.

2.3 ROOF-RAFTER FRAMING

- A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.

2.5 FASTENERS

- A. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
- B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 1. Fabricate framing assemblies using jigs or templates.
 2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

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- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
 - C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
 - D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
 - E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
 - F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

3.4 INSTALLATION OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

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

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 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 steel access ladders.
 - 2. Catwalk steel perimeter guards and flooring.
 - 3. Stainless steel reflector panels.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for structural steel framing supporting metal fabrication elements.

1.3 COORDINATION

- A. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, anchor bolts, and items with integral anchors, that are to be embedded in masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Metal ladders.
 - 2. Catwalk floor plates and perimeter guards.

1.5 INFORMATIONAL SUBMITTALS

- A. Research Reports: For post-installed anchors.
- B. Welding certificates.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Access Ladders: Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- B. Structural Performance of Catwalk Guards: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36.
- C. Steel Tubing: ASTM A500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Stainless Steel Sheets at Stage Radiators: ASTM A240 or ASTM A666, Type 304.
 - a. Finish: 2d dull, smooth, nonreflective.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum.
- B. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 2.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- B. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

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- D. Form exposed work with accurate angles and surfaces and straight edges.
 - E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 - G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 FABRICATION OF GUARD RAILINGS

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Connections: Fabricate railings with welded connections unless otherwise indicated.
- F. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- G. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.
- H. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- I. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- J. Toe Boards: provide toe boards at railings around openings and at edge of open-sided floors and platforms.

2.7 METAL LADDERS

- A. General:
1. Comply with ANSI A14.3.
- B. Steel Interior Access Ladders:
1. Space siderails 24 inches apart unless otherwise indicated.
 2. Siderails: Continuous tube, 3 inches deep, 3 inches wide, 1/4 inch thick.
 3. Side guards: 1-1/2" outside diameter continuous pipe.
 4. Rungs: 1-inch diameter, steel bars.
 5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 7. Support each ladder at top and bottom and as indicated on drawings with welded or bolted steel brackets.

2.8 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer.
- B. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
 - 1. For stainless steel wall panels, install per manufacturer's instruction using concealed fasteners / adhesives to in wall construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLATION OF GUARD RAILINGS

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.4 REPAIRS

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood blocking and nailers.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Lumber grading agencies, and abbreviations used to reference them, include the following:
 - 1. SPIB: The Southern Pine Inspection Bureau.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that

periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
- B. Maximum Moisture Content of Lumber:
 - 1. Boards: 15 percent.
 - 2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATMENT

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood nailers, curbs, equipment support bases, blocking, stripping, plywood substrate boards, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.
- B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.5 MISCELLANEOUS MATERIALS

- A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

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- B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- C. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- D. Comply with AWPAM4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. ICC-ES evaluation report for fastener.
- F. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 073126 - SLATE SHINGLES

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. Installation of salvaged slate shingles.
 - 2. New slate shingles in areas indicated on Drawings.
 - 3. Underlayment.
- B. Related Requirements:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for additional flashing requirements and materials.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
 - 1. Slate Shingles: Full size.
 - 2. Fasteners: Match existing condition for fasteners per tile in; type, length, and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each slate variety, based on evaluation of comprehensive tests performed by a qualified testing agency.
- B. Evaluation Reports: For synthetic underlayment, from ICC-ES or other testing and inspecting agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store underlayment rolls in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.
 - 1. Store on end, on pallets or other raised surfaces. Do not double-stack rolls.
- B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
- C. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide slate shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by Underwriters Laboratories Inc. or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 SLATE SHINGLES

- A. Slate Shingles: ASTM C 406/C 406M, Grade S1; hard, dense, and sound; with chamfered edges and nail holes machine punched or drilled and countersunk; with no broken or cracked slates, no broken exposed corners, and no broken corners on covered ends that could sacrifice nailing strength or laying of a watertight roof.
 - 1. Thickness and Surface Texture: Match existing nominal (F.V.) 3/16 inch +/-, rough.
 - 2. Length: Match existing, (F.V.) 18 inches +/-.
 - 3. Width: Match existing, 10 inches +/-.
 - 4. Nail Holes: Match Existing.
 - 5. Butt Shape: Match existing.
 - 6. Color: Match existing color. Architect to select from samples.
 - 7. Weather-Exposure Color Change: Unfading.
- B. Starter Slate: Slate shingles with chamfered nail holes front-side punched.
 - 1. Length: Exposure of slate shingle plus head lap.
 - 2. Butt Shape: Match existing.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil-thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release backing; cold applied.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - 2. Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Ice and Water Shield HT.
 - 3. Owens Corning; Weatherlock Metal High Temperature Underlayment.

2.4 ACCESSORIES

- A. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in slate-shingle roofing and remain watertight.
- C. Slating Nails: ASTM F 1667, copper, smooth-shanked, wire nails; 0.135-inch minimum thickness; sharp pointed; with 3/8-inch- minimum diameter flat head; of sufficient length to penetrate a minimum of 3/4 inch into sheathing.
 - 1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- D. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch minimum diameter.
 - 1. Provide cap nails complying with written recommendations of synthetic-underlayment manufacturer.
- E. Nailer Strips: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."
- F. Slate Reinstallation Hook: Copper, 3 inches long minimum shaft use to reinstall the top row of the salvaged and reinstalled slate tiles underneath the bottom row of existing slate to remain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provision has been made for flashings and penetrations through roofing.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches, staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.
 1. Extend self-adhering sheet underlayment over entire roof deck of area indicated on the drawings to be replaced.

3.3 SLATE-SHINGLE INSTALLATION

- A. General: Beginning at eaves, install slate shingles according to manufacturer's written instructions and to details and recommendations in NRCA's "NRCA Roofing Manual: Steep-Slope Roof Systems."
 1. Install shingle starter course chamfered face down.
- B. Install first and succeeding shingle courses chamfered face up. Install full-width first course at rake edge.
 1. Offset joints of uniform-width slate shingles by half the shingle width in succeeding courses.
- C. Maintain existing overlap.
- D. Maintain uniform exposure of shingle courses between eaves and ridge.
- E. Keep shingle starter course and succeeding courses flush with fasciae at rakes.
- F. Cut and fit slate neatly around roof hips.
- G. Slate shall be fastened with large-head slaters' copper nails to adequately penetrate roof boarding. Care shall be taken to avoid exposing the nails on cornice, soffits, overhanging eaves, etc.
- H. The heads of slating nails should just touch the slate and should not be driven "home" or draw the slate, but should be left with the heads just clearing the slate so that the slate hangs on the nail.

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- I. All nails shall penetrate the sheathing and not the joints between boards.
 - J. Slate shall be laid with a three-inch (3") head lap.
 - K. Each course shall break joints with the preceding one. The overlapping slate should be jointed as near the center of the underlying slate as possible.
 - L. Nails shall not be driven in so far as to produce a strain on the slate.
 - M. Cover all exposed nail heads with elastic cement. Hip slates shall be laid in elastic cement spread thickly over unexposed surface of under courses of slate, nailed securely in place, and pointed with elastic cement.
 - N. Install slate in pattern and layout to match existing slate installation on the dome.
 - O. Mix new matching slate with the salvaged slate to achieve uniform appearance.
 - P. For dome installation, vertical reference lines shall be snapped from the lower course to the peak around the entire dome. These lines shall taper as they progress from lower courses to the peak. Each piece of slate on a dome shape shall be cut to follow the tapered reference lines.
 - Q. Hips
 - 1. Install mitered hips with slates cut accurately to form tight joints.
 - 2. Fill joints in with plastic cement.
 - 3. Nail holes of each slate shall fall under the succeeding hip slate.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace damaged or broken slate shingles.
- B. Remove excess slate and debris from Project site.

END OF SECTION 073126

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

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. Ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Substrate board.
3. Accessory roofing materials
4. Vapor retarder.
5. Roof insulation.
6. Cover board.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Ethylene-propylene-diene-terpolymer (EPDM) roofing.
 2. Accessory roofing materials.
 3. Substrate board.
 4. Vapor retarder.
 5. Roof insulation.
 6. Insulation accessories and cover board.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 1. Layout and thickness of insulation.
 2. Base flashings and membrane terminations.
 3. Flashing details at penetrations.
 4. Tapered insulation, thickness, and slopes.
 5. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates:
 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of complying with performance requirements.
 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
 1. Field Test Reports:
 2. Concrete and poured gypsum internal relative humidity test reports.
- E. Field quality-control reports.

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- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
 - 2. Warranty Period: 20 years from Date of Substantial Completion.

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- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form in Division 01, Contractor's Roofing, Flashing and Sheet Metal Guarantee, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, for the following warranty period:
1. Warranty Period: Three years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings shall remain watertight.
1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
1. Fire/Windstorm Classification: Class 1A-90.
 - a. At Roof "A" – Zone 3: Class 1A-120.
 2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 SH.
- E. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
1. Wind Uplift Load Capacity: 90 psf.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

- A. EPDM Sheet Membrane: ASTM D4637, Type I, nonreinforced, uniform, flexible EPDM sheet. Minimum 0.060 inch thick compounded elastomeric membrane, largest sheet size possible as determined by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Syntec Systems.
 - b. Holcim Elevate
 - c. Versico Versiguard
 - 2. Composite Thickness: 0.060-inch-thick, nominal.
 - 3. Exposed Face Color: Black .
 - 4. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
- B. Flashing: Minimum 0.060-inch-thick uncured EPDM membrane. Provide longest pieces of flashing practicable.
- C. Bonding adhesive, splice wash solvent splicing cement, lap sealant, water cut-off mastic, prefabricated pipe seals, seam tape, nite seal, and pourable sealer: As recommended by sheet roofing manufacturer.
- D. Splice Wash: Clear splice wash or splice primer wash.
- E. Walkway Pads; Manufacturer's rubber walkway pads (size 30 inch by 30 inch by 0.300 inch thick) with seam tape laminated to the bottom.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- F. Seaming Material: Factory-applied seam tape, width as recommended by manufacturer.
- G. Lap Sealant: Manufacturer's standard, single-component sealant.
- H. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- I. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

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- J. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
 - K. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.
 - L. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.
 - 1. Provide white flashing accessories for white EPDM membrane roofing.

2.4 SUBSTRATE BOARDS

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.
 - c. USG Corporation.
 - 2. Thickness: Type X, 5/8 inch.
 - 3. Surface Finish: Factory primed .
 - 4. Installation Method:
 - a. Fully adhered to existing poured gypsum deck at Roof "A" indicated on drawings.
 - b. Mechanically fastened to existing cast-in-place concrete deck at Roofs "B" and "C" indicated on drawings.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck at cast-in-place concrete roof deck at Roof "B" indicated on drawings.

2.5 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.
- B. Glass-Fiber Felts: ASTM D2178/D2178M, Type IV, asphalt impregnated.

2.6 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam core with laminated inorganic coated glass reinforced mat facer, Type II, Class 2, complying with ASTM C 1289.
 - 1. Density: 2.0 pcf per ASTM D1522
 - 2. Compressive Strength: 20 psi minimum per ASTM D1621 Procedure A
 - 3. Meets FM 4450 and UL 1256

4. Moisture Vapor Transmission: 1.0 perms maximum.
 5. Thickness: Provide thickness and slope as indicated.
 6. Size: 48 by 48 inches.
- B. Tapered Insulation: ASTM C1289, Type II, Class 2, Grade 2 20 psi), provide factory-tapered insulation boards.
1. Slope: ¼ inch per foot unless otherwise indicated on Drawings.
- C. Insulation – General
1. Factory taper insulation to provide smooth incline of slopes as shown on drawings.
 - a. Factory miter valleys and corners.
 2. Multiple Layers: Furnish in not less than 2 layers.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to 1/2" inch per foot unless otherwise indicated on drawings.

2.7 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
- D. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum substrate.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Gold Bond Building Products, LLC provided by National Gypsum Company; DEXcell® Glass Mat Roof Board .
 - b. USG Corporation; Securock UltraLight Coated Glass-Mat Roof Board .
 2. Thickness: 1/2 inch.
 3. Surface Finish: Factory primed .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that concrete and poured gypsum substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than as recommended by roofing system manufacturer when tested according to ASTM F2170.
 - a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with not less than three test probes.
 - b. Submit test reports within 24 hours of performing tests.
5. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

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

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 1. Submit test result within 24 hours of performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.

3.5 INSTALLATION OF VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.
 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
 2. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
 - a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - c. Fill gaps exceeding 1/4 inch with insulation.
 - d. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.

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- d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - e. Trim insulation so that water flow is unrestricted.
 - f. Fill gaps exceeding 1/4 inch with insulation.
 - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- D. Installation Over Concrete Decks:
- 1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
 - a. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - b. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - c. At internal roof drains, slope insulation to create a square drain sump. Size as indicated on drawings.
 - 1) Trim insulation so that water flow is unrestricted.
 - d. Fill gaps exceeding 1/4 inch with insulation.
 - e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - f. Adhere base layer of insulation to vapor retarder according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
 - 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
 - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
 - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
 - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
 - 1) Trim insulation so that water is unrestricted.
 - e. Fill gaps exceeding 1/4 inch with insulation.
 - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - g. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.8 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll membrane roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.
 - 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
 - 2. Apply lap sealant and seal exposed edges of roofing terminations.
- I. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

- A. Refer to Division 01 Section "Contractor's Roofing/Flashing/Sheet Metal Guarantee".

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Formed roof-drainage sheet metal fabrications.
 - 2. Formed low-slope roof sheet metal fabrications.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 045000 "Exterior Historic Masonry Restoration" for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
 - 3. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.
 - 4. Section 077200 "Roof Accessories" for set-on-type curbs and other manufactured roof accessory units.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each sheet metal flashing and trim product.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, and keyed details. Distinguish between shop- and field-assembled Work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.

6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 1. For roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).
- C. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.
 - 1. Source Limitations: Obtain sheet from single source from single manufacturer.
 - 2. Nonpatinated, Exposed Finish: Mill.
- D. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
 - b. GCP Applied Technologies Inc.
 - c. Henry Company; a Carlisle company.
 - d. Owens Corning.
 - 2. Source Limitations: Obtain underlayment from single source from single manufacturer.
 - 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.
- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

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- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
 3. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
 4. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
 2. For Stainless Steel: ASTM B 32, Grade Sn96, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 1. Fabricated Hanger Style: Fig 1-35G according to SMACNA's "Architectural Sheet Metal Manual."
 2. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
 1. Stainless Steel: 0.0188 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop)[and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
 1. Joint Style: Overlapped, 4 inches wide.
 2. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch.

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- B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, weld watertight. Shop fabricate interior and exterior corners.
1. Coping Profile: As indicated on Drawings."
 2. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
 3. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
 - b. Stainless Steel: 0.040 inch thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch.
 2. Stainless Steel: 0.019 inch.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch.
 2. Stainless Steel: 0.019 inch.
- E. Rain Hood: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch thick.

2.8 FRAMED BIRD SCREEN

- A. Stainless Steel Angle: Bird screen frame welded at mitered corners.
1. Finish: 304 Stainless Steel, ASTM A276
 2. Size: 1" x 1" x 1/8" x required length (refer to drawings)
- B. Stainless Steel Bar: Intermediate Support welded to stainless steel angle frame.
1. Finish: 304 Stainless Steel, ASTM A276
 2. Size: 1" x 1/8" x required length (refer to drawings)
- C. Stainless Steel Wire Mesh: Welded to stainless steel angle frame and intermediate support.
1. Wire type: Plain Weave
 2. Wire Centers or opening 0.213
 3. Wire Diameter: 0.032
- D. Stainless Steel Fasteners
- E. Welding Qualifications: Qualify procedures and personnel according to the following.
1. AWS D1.6M, "Structural Welding Code – Stainless Steel."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
 - 5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.
- B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.

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6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 7. Do not field cut sheet metal flashing and trim by torch.
 8. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not use torches for soldering.
 2. Do not solder metallic-coated steel sheet.
 3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Downspouts:
 - 1. Join sections with 1-1/2-inch telescoping joints.
 - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 - 3. Locate hangers at top and bottom and at approximately 60 inches o.c.
 - 4. Provide elbows at base of downspout to direct water away from building.
- C. Splash Pans:
 - 1. Install where downspouts discharge on low-slope roofs.
 - 2. Set in elastomeric sealant compatible with the substrate.
- D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below discharge.

3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
 - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
 - 1. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
 - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
 - 2. Extend counterflashing 4 inches over base flashing.
 - 3. Lap counterflashing joints minimum of 4 inches.
 - 4. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

3.6 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.8 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Roof curbs.
2. Roof hatches.
3. Automatic smoke vents.
4. Access ladder safety posts.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal vertical ladders for access to roof hatches.
2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- a. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Greenheck Fan Corporation.
 - d. LMCurbs.
 - e. Roof Products and Systems (RPS) ; a division of Hart & Cooley, Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Zinc-coated (galvanized) steel sheet, 0.079 inch thick.
- E. Construction:
- 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
 - 4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
 - 5. Insulation: Factory insulated with 2-inch-thick glass-fiber board insulation.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
 - 8. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
 - 9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
- a. BILCO Company (The).
 - b. AES Industries, Inc.
 - c. Babcock-Davis.
 - d. JL Industries, Inc.; a division of the Activar Construction Products Group.
- B. Type and Size: Single-leaf lid, 40 by 40 inches clear opening. Field verify to match existing opening in roof.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.
- 1. Thickness: 14 gauge.

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2. Finish: Baked enamel or powder coat.
 3. Color: As selected by Architect from manufacturer's full range.
- E. Construction:
1. Insulation 2-inch- thick, polyisocyanurate board.
 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches (1060 mm); 4 inches above finished roof surface.
 2. Posts and Rails: 1-1/4 inches (31 mm) in diameter schedule 40 pipe in 6061 T6 aluminum.
 3. Flat Bar: Aluminum, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 5. Self-closing Gate: Fabricated of same materials and rail spacing as safety railing system. Provide stainless steel spring hinges and self-latching mechanism.
 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 7. Provide weep holes or other means to drain entrapped water in hollow sections of handrail and railing members.
 8. Fabricate joints exposed to weather to be watertight.
 9. Fasteners: All fasteners shall be stainless steel.
 10. Finish: Powder coat finish in rail 1018, safety yellow.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches above finished roof deck.
 3. Material: Steel tube.
 4. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 ACOUSTIC RATED SMOKE VENTS

- A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with double-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 360 deg F.
1. Basis-of-Design Product: Provide Bilco ACDSV Acoustic Rated Automatic Smoke Vent or approved equal by architect from one of the following that meets the project performance requirements:
 2. Type and Size: Double-leaf lid, 66 by 150 inches clear opening. Field verify to align with existing concrete curb and opening in roof deck
 3. Loads: Minimum 40-lbf/sq. ft. external live load and 90-lbf/sq. ft. internal uplift load.
 - a. When release is actuated, lid shall open against 10-lbf/sq. ft. snow or wind load and lock in position.
 - b. Maximum deflection: 1/150th of the overall span.
 4. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793 and are FM Approved.
 5. Corrosion resistant gas springs shall open the vent covers simultaneously when latch is manually released or when heat breaks the UL listed fusible link. Opening shall be in a controlled manner to avoid damage to surrounding roof surfaces.
 6. Sound Transmission Rating: Vent(s) shall carry STC-50 and OITC 46 sound ratings.
 7. ISO 140-18 Rainfall Sound Rating – 37.5 db.
 8. Curb, Framing, and Lid Material: Zinc-coated (galvanized) steel sheet.
 - a. Curb Thickness: 10-gauge with fixed center channel.
 - b. Cover Thickness: 14-gauge steel with formed reinforcing members.
 - c. Finish: Mill finish.
 9. Construction:
 - a. Insulation: 4-inch mineral wool insulation
 - b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 - c. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - d. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - e. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 10. Lifting mechanisms: Corrosion resistant gas springs open covers automatically against a 10 lb/ft² (49Kg/m²) snow/wind load. Gas springs shall have built in dampers to assure a controlled rate of opening and automatically lock the covers in the full open position. A release mechanism shall be provided to allow the covers to be closed.
 11. Latch mechanism: Manufacturer's hold/release mechanism with a separate latching point for each cover controlled by a single UL listed 360°F (74°C) fusible link and electrically connected to and activated by the existing fire protection systems. Fusible link shall be

- curb mounted on a non-hinged end to allow the latching mechanism to be easily reset from the roof level.
- a. Covers shall operate only when activated:
 - 1) Manually
 - 2) By heat at fusible link
 - 3) Electrically by signal from existing fire protection systems.
 - a) Provide 115 VAC, 60 CY., 0.25 Amps.
 12. Hardware: Corrosion resistant gas struts and hot dip galvanized steel stop cables. All other hardware is zinc plated/chromate sealed.
 13. Provide manufacturer's
- B. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches (1060 mm); 4 inches above finished roof surface.
 2. Posts and Rails: 1-1/4 inches (31 mm) in diameter schedule 40 pipe in 6061 T6 aluminum.
 3. Flat Bar: Aluminum, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 6. Provide weep holes or other means to drain entrapped water in hollow sections of handrail and railing members.
 7. Fabricate joints exposed to weather to be watertight.
 8. Fasteners: All fasteners shall be stainless steel.
 9. Finish: Powder coat finish in rail 1018, safety yellow.

2.5 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post according to manufacturer's written instructions.

E. Heat and Smoke Vent Installation:

1. Install heat and smoke vent so top perimeter surfaces are level.
2. Install and test heat and smoke vents and their components for proper operation according to NFPA 204.
3. Attach safety railing system to hatch curb.

F. Roof Walkway Installation:

1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.

G. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 079200 - 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. Silicone joint sealants.

1.3 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. 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 joint sealant, for tests performed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

1.5 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.

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- 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.

1.6 FIELD 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.
 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.

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: Ten 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 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 manufacturer, based on testing and field experience.
- B. 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, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 795.
 - b. Master Builders; Master Seal NP100.
 - c. Pecora Corporation; 895NST.
 - d. Tremco Incorporated; Spectrem 3.

2.3 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 manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bi-cellular polyethylene foam backer rod), 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 manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, 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: Non-staining, nonabsorbent 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.

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- 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.
 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. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 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 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.

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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.
 - a. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than ½ inch deep or less than ¼ inch deep.
 - b. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75% - 125% of joint width.
 - F. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces. Clean the adjoining surfaces by whatever means necessary to eliminate evidence of spillage.
 - G. Do not overheat hot-applied sealants.
 - H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
- 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 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints in natural stone cladding and coping.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors and louvers.
 - e. Other exterior joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, Non-Staining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Interior mold-resistant gypsum board.
 2. Glass-fiber blanket insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Mold-resistant gypsum board.
 2. Glass-fiber blanket insulation.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Mold-Resistant Gypsum Board: ASTM C1396. With moisture- and mold-resistant core and paper surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Building Products.
 - b. National Gypsum Company.
 - c. USG Corporation.
 2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
1. Material: Paper-faced galvanized-steel sheet.
 2. Shapes:
 - a. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - b. L-Bead: L-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- 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, rounded or beveled panel edges, 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 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville; a Berkshire Hathaway company.
 - 3. Knauf Insulation.
 - 4. Owens Corning.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- 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 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

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- B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- D. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.3 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. 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.
- C. Locate edge and end joints over supports. 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.
- D. Form control and expansion joints with space between edges of adjoining gypsum panels.
- E. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
1. Fit gypsum panels around ducts, pipes, and conduits.
 2. 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.
- F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- 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.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both

faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

- I. Install blanket thermal insulation before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.4 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On partitions/walls, apply gypsum panels horizontally (perpendicular 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.
2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.5 INSTALLATION OF TRIM ACCESSORIES

- A. General: 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 C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. LC-Bead: Use at exposed panel edges.

3.6 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, rounded or beveled edges, 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 C840:
 1. Level 3: Where indicated on Drawings

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 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 092900

SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 high-performance coating systems **on the following substrates:**
 - 1. Exterior Substrates:
 - a. Steel.
 - b. Galvanized metal.
 - c. Wood.
 - 2. Interior Substrates:
 - a. Steel
 - b. Gypsum board.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.

1.3 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

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.

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- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 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 coating 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 that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Coatings: **1 small kit** 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.
 - 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 coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each paint product from single source from single manufacturer.
- B. Provide products indicated in the High-Performance Coating Schedules at the end of Part 3 this section.

2.2 HIGH-PERFORMANCE COATINGS, 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. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

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. Wood: 15 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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 coating 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 coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

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1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating 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. Exterior Exposure: SSPC-SP 6 Commercial Blast Cleaning.
 - a. If conditions will not permit commercial blast cleaning, then prepare exterior steel substrates with SSPC-SP 3 Power Tool Cleaning with a minimum of a 1.0 mil angular surface profile. Confirm with Architect that this method is acceptable in lieu of commercial blast cleaning prior to cleaning substrates.
 2. Interior Exposure: SSPC-SP 6 Commercial Blast Cleaning with a minimum of a 1.5 mil angular surface profile.
- 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.
1. Remove any streaking and patch and blend scratches and chips in shop-applied primer.
- F. Galvanized-Metal Substrates: Remove any existing coatings, grease and oil residue from galvanized metal by any means feasible. Prepare substrate in accordance with SSPC-SP 16 with a minimum angular profile of 1.5 mils. A test patch shall be provided to ensure proper adhesion to the substrate.
- G. Wood Substrates:
1. Scrape and clean knots. Before applying primer, apply coat of knot sealer that is recommended in writing by topcoat manufacturer for coating 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 filler that is recommended in writing by topcoat manufacturer for coating system indicated. Sand smooth when dried.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in coating schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturer.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

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 coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating 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 coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel and Iron Substrates:
 - 1. Aliphatic Acrylic Polyurethane Coating System:
 - a. Primer: Urethane, zinc-rich two-component primer.
 - 1) Tnemec; Series 90-97 Tneme-Zinc. Applied at 2.5-3.5 mils DFT.
 - b. Intermediate Coat: Polyamidoamine epoxy coating.
 - 1) Tnemec; Series N69 Hi-Build Epoxoline II. Applied at 2.0-3.0 mils DFT.
 - c. Topcoat: Low VOC, aliphatic acrylic polyurethane. Finish: Gloss.
 - 1) Tnemec; Series 1094 Endura-Shield. Applied at 2.0-3.0 mils DFT.
- B. Gypsum Board Substrates:
 - 1. High Dispersion Pure Acrylic Polymer Coating System:
 - a. Primer: Waterborne, modified polyamine epoxy penetrating primer.
 - 1) Tnemec; Series 151-1051 Elasto-Grip FC. Applied at 0.7-1.5 mils DFT.
 - b. Intermediate Coat: HDP acrylic polymer coating.
 - 1) Tnemec Series 1028 Enduratone. Applied at 2.0-3.0 mils DFT.
 - c. Top Coat: Matching Intermediate Coat. Finish: Gloss.
 - 1) Tnemec Series 1028 Enduratone. Applied at 2.0-3.0 mils DFT.

3.7 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel and Iron Substrates:
 - 1. Thermoset Fluoropolymer Coating System:
 - a. Primer: modified aromatic polyurethane primer.
 - 1) Tnemec; Series 1 Omnithane. Applied at 2.5-3.5 mils DFT.
 - b. Intermediate Coat: Aliphatic acrylic polyurethane. Low VOC.
 - 1) Tnemec; Series 1095 Endura-Shield. Applied at 2.0-3.0 mils DFT.
 - c. Topcoat: Exterior, Thermoset Fluoropolymer, Pigmented, Gloss.
 - 1) Tnemec; Series 1070 Fluouronar. Applied at 2.0-3.0 mils DFT.
- B. Galvanized-Metal Substrates:
 - 1. Thermoset Fluoropolymer Coating System:
 - a. Primer: Polyamidoamine epoxy primer.
 - 1) Tnemec; Series N69 Hi-Build Epoxoline II. Applied at 2.0-3.0 mils DFT.
 - b. Topcoat: Exterior, Thermoset Fluoropolymer, Pigmented, Gloss.
 - 1) Tnemec; Series 1070 Fluouronar. Applied at 2.0-3.0 mils DFT.
- C. Wood Substrates:
 - 1. High Dispersion Pure Acrylic Polymer Coating System:
 - a. Primer: Waterborne, modified polyamine epoxy penetrating primer.
 - 1) Tnemec; Series 151-1051 Elasto-Grip FC. Applied at 0.7-1.5 mils DFT.
 - b. Intermediate Coat: HDP acrylic polymer coating.
 - 1) Tnemec Series 1028 Enduratone. Applied at 2.0-3.0 mils DFT.
 - c. Top Coat: Matching Intermediate Coat. Finish: Gloss.
 - 1) Tnemec Series 1028 Enduratone. Applied at 2.0-3.0 mils DFT.

END OF SECTION 099600

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Project record drawings.
 - 9. Plumbing demolition.
 - 10. Equipment installation requirements common to equipment sections.
 - 11. Painting and finishing.
 - 12. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the Contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Plumbing work to comply with International Plumbing Code (IPC) as listed on Drawings and General Conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- F. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

1.8 SCHEDULING AND PHASING

- A. All plumbing work shall be scheduled to meet project completion date. Plumbing work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. Acceptable Manufacturers:

1. Cascade Waterworks Mfg. Co.
2. Dresser Industries, Inc.; DMD Div.
3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
4. JCM Industries.
5. Smith-Blair, Inc.
6. Viking Johnson.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Acceptable Manufacturers:

1. Capitol Manufacturing Co.
2. Victaulic Company
3. Calpico, Inc.
4. Epco Sales, Inc.
5. Hart Industries, International, Inc.
6. Lochinvar Corp.
7. Watts Industries, Inc.; Water Products Div.
8. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F. Victaulic Style 47.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Acceptable Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Link Seal
 - d. Metraflex Co.
 - e. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 COORDINATION DRAWINGS

- A. The contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
 - 1. Plumbing piping routing including drops to fixtures, risers, etc.
- B. The contractor shall submit the CAD generated drawings to mechanical contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by HVAC Contractor.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access. In general install piping tight to slab, beams, joists and structural members if possible.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

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- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

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- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- U. Draining and Refilling of Systems: Provide all shutoff valves, drain valves, pipe, fittings, and miscellaneous material required to drain each existing system as required for new work. After new work is completed, tested, and found tight, refill each system as required. Time for shutting down existing system for draining shall be coordinated with all other work and with Owner's representative. Cost for all chemicals and additives for refill shall be borne by the Contractor.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "High Performance Coatings."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.7 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout around anchors.
- G. Cure placed grout.

END OF SECTION 220500

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
 - 4. Pipe positioning systems.

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- B. Welding certificates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Acceptable Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Carpenter & Paterson, Inc.
 3. Empire Industries, Inc.
 4. Globe Pipe Hanger Products, Inc.
 5. Grinnell Corp.
 6. GS Metals Corp.
 7. National Pipe Hanger Corporation.
 8. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Acceptable Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.

2. GS Metals Corp.
3. Power-Strut Div.; Tyco International, Ltd.
4. Thomas & Betts Corporation.
5. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Acceptable Manufacturers:

1. Carpenter & Paterson, Inc.
2. PHS Industries, Inc.
3. Pipe Shields, Inc.
4. Rilco Manufacturing Company, Inc.
5. Value Engineered Products, Inc.
6. Armacell, LLC.

C. Insulation-Insert for Cold Piping: Single piece closed cell insulation with 30 mil thick painted aluminum outer shell and self-adhesive closure (Armafix IPH).

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Acceptable Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20), from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

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4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

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- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Joint Stress: Install hangers and supports to provide indicated pipe slopes so maximum pipe deflections and joint stresses allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

END OF SECTION 220529

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following storm drainage piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - 2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

2.5 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - 1. Center-Sleeve Material: Manufacturer's standard.
 - 2. Gasket Material: Natural or synthetic rubber.
 - 3. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing".
- B. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook", Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings".
- D. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- F. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

- D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment". Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6: 60 inches with 3/4-inch rod.
 5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Metal cleanouts.
 - 2. Through-penetration firestop assemblies.
 - 3. Roof drains.
 - 4. Miscellaneous storm drainage piping specialties.
 - 5. Flashing materials.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 METAL CLEANOUTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Tyler Pipe; Wade Div.
 - 4. Watts Drainage Products Inc.
 - 5. Zurn Industries, LLC.

B. Exposed Metal Cleanouts:

1. Standard: ASME A112.36.2M for cast iron/ASME A112.3.1 for stainless steel for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: As required to match connected piping.
4. Closure: Brass or cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Closure: Stainless-steel plug with seal.

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected pipe.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.3 ROOF DRAINS

A. Metal Roof Drains:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Drainage Products Inc.
 - e. Zurn Industries.
2. Standard: ASME A112.21.2M.
3. Pattern: Balcony/Canopy/Promenade-deck/Roof/Scupper drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom or Side.
8. Dome Material: Cast iron.
9. Extension Collars: Required.
10. Underdeck Clamp: Required.
11. Sump Receiver: Not required.

2.4 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Overflow Downspout Covers:
1. Description: Stainless steel with threaded inlet and stainless steel flange with fabricated secured hinged slotted grate.
 2. Size: Same as connected storm piping.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.
1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Position roof drains for easy access and maintenance.

- D. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- E. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- F. Install overflow downspout covers at locations indicated on drawings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 230500 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Scope of Work:
 - 1. Plumbing Work: Refer to Section 220500 "Basic Plumbing Requirements".
 - 2. Heating Work shall include, but is not necessarily limited to:
 - a. Relocating existing finned tube radiation. Extend existing steam distribution system including piping, insulation, terminal heating equipment, traps, and specialties.
 - b. gas piping system including all meter requirements.
 - c. Extend existing chilled water system including piping and insulation Make final connections to all coils, including those furnished by others.
 - d. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
 - e. Complete all applicable tests, certifications, forms, and matrices.
 - 3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - b. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - 4. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing as specified in Section 230593, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
 - b. Complete all applicable tests, certifications, forms, and matrices

1.3 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

1.4 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Heating Contractor.
 - b. Air Conditioning and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

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5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Columbia, Missouri Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of the University of Missouri.
3. Conform to all State Codes.
4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

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5. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
 6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
 7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
 8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.6 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
 1. Submittals List:

Referenced Specification	Submittal Item
Section	
230513	Motors
230529	Hangers and Supports
230553	HVAC Identification
230593	Testing, Adjusting, and Balancing
230713	Duct Insulation
230719	HVAC Pipe Insulation
23 09 00	Controls
232100	Hydronic Piping Systems and Valves
232200	Steam and Condensate Piping Systems and Valves
232218	Traps and Condensate Return Equipment
233100	Ductwork
237323	Custom Air Handling Units
238216	Coils

B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

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4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
 6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.

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10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
 16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 23 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

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- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:
1. Motor windings and ventilation openings.
 2. Bearings.
 3. Equipment Pipe and Accessories connections openings. (e.g. boiler connections, coil connections, etc.)
 4. Equipment Duct and Accessories connections openings. (e.g. AHU/RTU duct connections; Terminal Air Boxes, etc.)
 5. Starter and control cabinets.
 6. Heat transfer coils.
 7. Pump Seals.
 8. Combustion burner and blower equipment (e.g. combustion air intake, combustion vent/flue, etc.)
- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.
- 1.9 NETWORK / INTERNET CONNECTED EQUIPMENT
- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- 1.10 WARRANTY
- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

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- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.
- 1.11 INSURANCE
- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.
- 1.12 MATERIAL SUBSTITUTION
- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 01.
- B. Final Jobsite Observation:
1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
 4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- C. Before final payment is authorized, this Contractor must submit the following:
1. Operation and maintenance manuals with copies of approved shop drawings.
 2. Record documents including marked-up drawings and specifications.
 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
 4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
 5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 230900 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.

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7. Copies of warranties.
 8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 9. Dimensional drawings of equipment.
 10. Capacities and utility consumption of equipment.
 11. Detailed parts lists with lists of suppliers.
 12. Operating procedures for each system.
 13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 14. Repair procedures for major components.
 15. List of lubricants in all equipment and recommended frequency of lubrication.
 16. Instruction books, cards, and manuals furnished with the equipment.

3.5 SYSTEM STARTING AND ADJUSTING

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.
- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

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- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
 - D. Refer to Section 230900 for additional requirements for Temperature Control documents.
 - E. Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.
 - F. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
 - G. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
 - H. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.7 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- C. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.
 - 3. Color of paint shall be as follows:
 - a. Piping exposed in Stage:
 - 1) All Piping: Black

3.8 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

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- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
 - C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.
 - D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.10 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

- A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.
- B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.
- C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.
- D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.
- E. The following steps shall be taken during testing, adjusting, and balancing of each air system:
 - 1. All construction activities in all spaces served by the air system shall stop.
 - 2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
 - 3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.
 - 4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.

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- F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
4. All temperature control systems operating, programmed and calibrated.
5. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION 230500

SECTION 230505 - HVAC DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Mechanical demolition.
- B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

- A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.

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- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.
 - C. Existing Heating System: Maintain existing system in service until new system is complete and ready for service. Drain system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before partially or completely draining system. Minimize outage duration.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Repair adjacent construction and finishes damaged during demolition and extension work.
- D. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- E. Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 6" of the last branch. End caps shall be 3" pressure class and seal class "A".
- F. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

END OF SECTION 230505

SECTION 230513 - MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- E. ANSI/NEMA MG 1 - Motors and Generators.
- F. ANSI/NFPA 70 - National Electrical Code.
- G. Energy Independence and Security Act of 2007.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 230500. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.
- B. Submit shop drawings for all three phase motors.
- C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.
- D. Submit shaft grounding rings or brushes or ceramic bearings for all motors as required.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.
- G. Each contractor shall set all motors furnished by him.
- H. All motors shall have a minimum service factor of 1.15.
- I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- J. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.
- K. Aluminum end housings are not permitted on motors 15 HP or larger.

L. Motor Driven Equipment:

1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

N. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.

2.2 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall integral surge protection. Motor shall be pre-wired for specific voltage and phase.
- B. Motor frame shall be NEMA 48; UL recognized components shall be provided for the motor construction.
- C. All EC motors shall be a minimum of 85% efficient at all speeds.
- D. Motors shall be permanently lubricated; utilize ball bearings to match with the connected driven equipment.
- E. Provide motor with on-board motor control module. Motor speed shall be limited to provide electronic over current protection. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed.
- F. Operational mode shall be as scheduled and shall be one of the following:
 1. Constant Flow
 2. Constant Temperature
 3. Constant Pressure

2.3 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

- A. All motors, unless exempted by EPA legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

B. Motor nameplate shall be noted with the above ratings.

2.4 MOTORS ON VARIABLE FREQUENCY DRIVES

- A. All motors driven by VFDs shall be premium efficiency type.
- B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.
- C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors."

2.5 SHEAVES

- A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.
- B. When replacing sheaves, use sheaves of at least the originally supplied sizes.
- C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.
- C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

END OF SECTION 230513

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SECTION 230529 - HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Flashing and Sealing of Equipment and Pipe Stacks.
- C. Cutting of Openings.
- D. Escutcheon Plates and Trim.

1.2 REFERENCES

- A. ANSI/ASME B31.1 - Power Piping.
- B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- E. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 230500. Include plastic pipe manufacturers' support spacing requirements.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:
 - 1. Steel Pipe:
 - a. Hanger Rod Diameter:
 - 1) 2-1/2" and smaller: 3/8"
 - 2) 3" through 3-5/8": 3/8"
 - 3) 4" through 6": 1/2"
 - 4) 8": 5/8"
 - 5) 10": 3/4"
 - 6) 12": 7/8"
 - 7) 14" and 16": 1"
 - 8) 18" and 24": 1-1/4"

2. Copper, Plastic and Fiberglass Reinforced Pipe:

a. Hanger Rod Diameter:

- 1) 2-1/2" and smaller: 3/8"
- 2) 3") through 3-5/8": 3/8"
- 3) 4") through 6": 1/2"
- 4) 8": 5/8"
- 5) 10": 3/4"
- 6) 12": 7/8"
- 7) 14" and 16": 1"
- 8) 18" and 24": 1-1/4"

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

1. Outdoor piping supports..

2.2 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

a. Products:

- 1) Eaton Fig B3373 Series
- 2) nVent 510 Series
- 3) Anvil Fig. 90

2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

a. Products:

-
- 1) Mason RBA, RCA or RDA
 - 2) Mason BR
3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.
- a. Products:
- 1) Pipeshields E100
4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
 2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65°F to +275°F.
 3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
 4. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
- a. Products:
- 1) Anvil Fig. 160, 161, 162, 163, 164, 165
 - 2) Eaton Fig. 3160, 3161, 3162, 3163, 3164, 3165
 - 3) nVent Model 630, 631, 632, 633, 634, 635
5. Unless otherwise indicated, hangers shall be as follows:
- a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and Smaller:
- 1) Products: Bare Steel, Plastic or Insulated Pipe:
 - a) Anvil Fig. 260
 - b) Eaton Fig. 3100
 - c) nVent Model 400
 - 2) Products: Bare Copper Pipe:
 - a) Eaton Fig. B3104F or B3100CTC
 - b) Anvil Fig. CT65
 - c) nVent Fig. 402

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6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
 - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
 - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

 7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
 - a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller:
 - 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
 - 2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
 - 3) Products: Bare Steel, Plastic or Insulated Pipe:
 - a) Unistrut Fig. P1100 or P2500
 - b) Eaton Fig. B2000 or B2400
 - c) Anvil Fig. AS1200
 - d) nVent USC
 - 4) Products: Bare Copper Pipe:
 - a) Eaton Fig. BVT
 - b) nVent CADDY Cushion Clamp

 - D. Upper (Structural) Attachments:
 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
 - a. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-20. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
 - b. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
 - c. Steel Structure Welding:
 - 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.3 ROOF PENETRATIONS

- A. Conical Pipe Boot: Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color: Black shall match roofing material.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.4 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.5 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.6 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.7 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

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4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with Sheet Metal Contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
 2. Set all concrete inserts in place before pouring concrete.
 3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
 4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
 5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- C. Pipe Requirements:
1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
 3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
 4. Piping shall not introduce strains or distortion to connected equipment.
 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
 3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

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- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" & larger: 12'-0"
 2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" and under: 9'-0"
 - 2) 1-1/2": 12'-0"
 - 3) 2" & larger: 12'-0"
 3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"
 4. Hard Drawn Copper & Brass (Vapor Service):
 - a. Maximum Spacing:
 - 1) 3/4" & under: 7'-0"
 - 2) 1": 8'-0"

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- 3) 1-1/4": 9'-0"
 - 4) 1-1/2": 10'-0"
 - 5) 2": 11'-0"
 - 6) 2-1/2" & larger: 12'-0"

5. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:

a. Continuous channel with hangers maximum 8'-0" OC.

I. Installation of hangers shall conform to MSS SP-58, 69, and 89.

END OF SECTION 230529

SECTION 230553 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

1.2 REFERENCES

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM B-1, B-3, and B-8 for copper conductors.
- C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 - 2kV Cables.
- D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
- E. NFPA-99 - Health Care Facilities.
- F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 230500. Include list of items identified, wording, letter sizes, and color coding.
- B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 3M
- B. Craftmark
- C. Kolbi Industries
- D. Seton
- E. W.H. Brady
- F. Marking Services.

2.2 MATERIALS

A. General:

1. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
2. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

B. Pipe Markers:

1. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

2. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
3. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
4. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.

- B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.
2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
5. Attach to handwheel or around valve stem.
6. Number all tags and show the service of the pipe.
7. Provide two sets of laminated 8-1/2" x 11" (letter size) copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

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1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
 3. Stencil Painted Pipe Markers:
 - a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
 - b. Apply primer on non-insulated pipes before painting.
 - c. Use background and letter colors as scheduled later in this section.
 4. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:

1. STEAM - 15 PSI: Black lettering; yellow background
2. LOW PRESSURE CONDENSATE: Black lettering; yellow background
3. PUMPED CONDENSATE: Black lettering; yellow background
4. CHILLED WATER SUPPLY: White lettering; green background
5. CHILLED WATER RETURN: White lettering; green background
6. CONDENSATE DRAIN: White lettering; green background
7. COMPRESSED AIR: White lettering; green background
8. CONTROL COMPRESSED AIR: White lettering; green background

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- B. Steam pipe markers shall include operating steam pressure within pipes shown above.

END OF SECTION 230553

SECTION 230713 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials:
 - 1. Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
 - 2. Fungal Resistance: No growth when tested in accordance with ASTM G21 (antifungal test).
 - 3. Rated velocity on coated air side for air erosion in accordance with UL 181 at 5,000 fpm minimum.
 - 4. UL listed in Category HNKT.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

1.3 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.
- F. ASTM E814 - Fire Tests of Through Penetrations Firestops.
- G. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

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- J. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
 - K. NFPA 255 - Surface Burning Characteristics of Building Materials.
 - L. UL - XHEZ - Through Penetration Firestop Systems.
 - M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 - N. UL 263 - Full Scale External Fire Tests with Hose Stream.
 - O. UL 723 - Surface Burning Characteristics of Building Materials.
 - P. UL 1479 - Fire Tests of Through Penetrations Firestops.
- 1.4 SUBMITTALS
- A. Submit shop drawings per Section 230500. Include product description, list of materials and thickness for each service, and location.
 - B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75°F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.
- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim Kraft facing, 3 lb./cu. ft. density.
- C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 5000 fpm air velocity.
- D. Type D: Rigid Fiberglass Liner; 0.23 maximum 'K' value at 75°F; smooth coated mat facing laminated to the insulation, suitable for 5000 fpm air side velocity.

2.2 JACKETS

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.

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- B. Install materials after ductwork has been tested.
 - C. Clean surfaces for adhesives.
 - D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
 - E. Exterior Duct Wrap - Flexible, Type A:
 - 1. Apply with edges tightly butted.
 - 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
 - 3. Seal joints with adhesive backed tape.
 - 4. Apply so insulation conforms uniformly and firmly to duct.
 - 5. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.
 - 6. Provide high-density insulation inserts on rectangular ducts at trapeze duct hangers to prevent crushing of insulation. Provide high-density insulation inserts with clamp-on round ducts requiring two (2) rods or straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
 - 7. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
 - 8. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
 - 9. Staples may be used, but must be covered with tape.
 - 10. Vapor barrier must be continuous.
 - 11. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.
 - F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):
 - 1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
 - 2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
 - 3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
 - 4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.
 - G. Semi Rigid Fiberglass Board Wrap - Type B (Outdoor Use):
 - 1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
 - 2. Space pins as required to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
 - 3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of the same facing tape with adhesive.
 - 4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.
 - 5. Install vapor barrier jacket. Cover with aluminum jacket covering with seams on the bottom of horizontal ductwork.

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6. Seal all butt joints with metal draw bands screwed to jacket and filled with sealant. Seal all joints watertight.
 7. Provide positive slope on top of all horizontal surfaces to prevent ponding of water.
- H. Interior Insulation - Flexible Duct Liner, Type C:
1. Observation of Duct Lining:
 - a. After installation of ductwork, Architect/Engineer may select random observation points in each system.
 - 1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.
 - 2) Random observation points based on one opening per 75 lineal ft. of total duct run.
 - b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.
 - c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.
 - d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 233300.
 - e. Paint or finish to match adjacent duct surfaces.
 2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.
 3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
 4. Install per the latest edition of the SMACNA Manual.
 5. Leading edges shall be covered as follows:
 - a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.
 - b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.
 - c. Install metal nosing in the following locations (regardless of velocity):
 - 1) The first three fittings downstream of all fans.
 - 2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
 - 3) Trailing edges of transverse joints do not require metal nosings.

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6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.
 7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
 8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

I. Plenum Walls - Type D:

1. Brush apply adhesive to the wall before installing insulation. Provide 100% coverage.
2. Apply pins to the wall with adhesive. Locate pins 15" O.C. maximum and within 2" of all insulation edges.
3. Secure insulation to pins with speed clips and cut all pins off close to the clips. Cover raw ends of pins with glass fabric set in adhesive.
4. Cover all joints with 3" wide strips of glass fabric set in adhesive.
5. Protect all door openings with sheet metal angles.

J. Continue insulation with vapor barrier through penetrations unless code prohibits.

K. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

3.2 SCHEDULE

A. Refer to Section 233100 for scheduling of insulation.

END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

1.3 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- D. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

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- J. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
 - K. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
 - L. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
 - M. ASTM E84 - Surface Burning Characteristics of Building Materials.
 - N. NFPA 255 - Surface Burning Characteristics of Building Materials.
 - O. UL 723 - Surface Burning Characteristics of Building Materials.
 - P. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- 1.4 SUBMITTALS
- A. Submit shop drawings per Section 230500. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
- B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.
- C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.29 maximum 'K' value at 75°F; density 7.3lb/ft; minimum compressive strength 90 psi parallel to rise; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose polymer or polypropylene service jacket for above grade installations.
- D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

2.2 VAPOR BARRIER JACKETS

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.
- B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

3.2 INSTALLATION

- A. General Installation Requirements:
 - 1. Install materials per manufacturer's instructions, building codes and industry standards.
 - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
 - 3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
 - 4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.
- B. Insulated Piping Operating Below 60°F:
 - 1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
 - 2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
 - 3. All balance valves and strainers with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 SUPPORT PROTECTION

A. Provide a shield on all insulated piping at each support between the insulation jacket and the support.

B. On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:

1. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
 - a. Cellular glass (Type C) (for all temperature ranges) with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14, provide rolled steel plate in addition to the shield.
 - b. Molded hydrous calcium silicate (Type D) (only use for pipes with operating temperatures above 90°F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - c. As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
 - 1) Products:
 - a) Buckaroo CoolDry
 - b) Cooper/B-Line Fig. B3380 through B3384
 - c) Pipe Shields A1000, A2000

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- d. Insulation Couplings:
- 1) Molded thermoplastic slip coupling, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
 - 2) PET thermoplastic foam load bearing core with elastomeric foam ends and lap-seal jacket.
 - 3) Horizontal Strut Mounted Insulated Pipe Manufacturers:
 - a) Klo-Shure or equal
 - b) Armafix Ecolight
 - 4) Vertical Manufacturers:
 - a) Manufacturers: Klo-Shure Titan or equal
- e. Rectangular blocks, plugs, or wood material are not acceptable.
- f. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.
- C. Neatly finish insulation at supports, protrusions, and interruptions.
- D. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
- E. Shields shall be at least the following lengths and gauges:
- | Pipe Size | Shield Size |
|----------------|---------------------|
| 1/2" to 3-1/2" | 12" long x 18 gauge |
| 4" | 12" long x 16 gauge |
| 5" to 6" | 18" long x 16 gauge |
| 8" to 14" | 24" long x 14 gauge |
| 16" to 24" | 24" long x 12 gauge |
- F. Elastomeric foam insulation shields/saddle; molded thermoplastic rigid pipe saddle sized for insulation outside diameter. Length as indicated above.
- G. Ferrous hot piping 4 inches (100 mm) and larger, provide steel saddle at rollers as described in Section 230529 "HVAC Supports and Anchors".
- H. Minimum 1/4" rolled galvanized steel plates shall be provided in addition to the sleeves as reinforcement on large pipes to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength. Refer to section above for exact locations.

3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Exterior installations shall contain factory applied polymeric, moisture, and UV resistant covering with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:
 - a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
2. Insulate fittings with prefabricated fittings.

D. Type D Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

3.5 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
3. Interior joints do not need to be sealed.
4. Use metal covering on the following pipes:
 - a. All Type D insulation.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
 - a. All exposed piping in finished spaces unless noted otherwise on the drawings.
 - b. All exposed piping in unfinished areas as noted on drawings (e.g., storage rooms, janitor's closets, utility rooms, etc.).
 - c. All exposed piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

3.6 SCHEDULE

- A. Refer to drawings for insulation schedule.

END OF SECTION 230719

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SECTION 230900 - CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. University of Missouri Controls Specification.
- B. This section contains requirements for pneumatic, electric and digital control systems as indicated on the contract drawings.
- C. Contractor is responsible for providing, installing and connecting all sensors, pneumatic actuators, control valves, control dampers, electrical components and all interconnecting pneumatic tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).
- D. DDC systems consist of Johnson Controls METASYS controllers. Contractor shall install owner provided control enclosures. Owner will provide and install controllers. After all equipment has been installed, wired and piped, Owner will be responsible for all termination connections at the DDC controller's and for checking, testing, programming and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.
- E. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.3 QUALITY ASSURANCE

- A. Contractor's Qualifications:
 - 1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years' experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Condition's section 3.4.1 and 3.4.4.
- B. Codes and Standards:
 - 1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
 - 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

4. NFPA Compliance: Comply with NFPA 70 "National Electric Code."

1.4 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for each control system, containing the following information:
- B. Product data for each damper, valve, and control device.
- C. Label each control device with setting or adjustable range of control.
- D. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- E. Include written description of sequence of operation.
- F. Provide wiring diagrams of contractor provided interface and I/O panels.
- G. Provide field routing of proposed network bus diagram listing all devices on bus.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Air Piping:
 - 1. Copper Tubing: Seamless copper tubing, Type M or L, ASTM B 88; wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment.
 - 2. Flex Tubing: Virgin Polyethylene non-metallic tubing, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on polyethylene fittings. Tubing used above suspended ceilings to be plenum rated per NFPA 90A. See section 3.1.b for locations where flex tubing can be used.
 - 3. Copper to polyethylene connections shall be compression barbed fittings or solder barbed fittings.
- B. Conduit and Raceway:
 - 1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.
 - 2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.
 - 3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.
 - 4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.
- C. Control Valves: Provide factory fabricated pneumatic or electric control valves of type, body material, and pressure class as indicated on the drawings. Butterfly style control valves are not acceptable except for two position applications. Equip control valves with heavy-duty actuators, with proper shutoff rating for each individual application.
 - 1. Hydronic Chilled Water and Heating Water

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- a. At minimum, hydronic control valves shall be pressure independent. High performing energy monitoring control valves may be considered depending on the project. The flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations across the valve in the selected operating range. The control valve shall accurately control the flow from 1 to 100% full rated flow.
 - b. The valve bodies shall be of cast iron, steel or bronze and rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass, or bronze.
 - c. DeltaP Valves manufactured by Flow Control Industries, Belimo, Danfoss Series, or approved equal.
 - d. The valves shall have pressure taps across the valve for measuring the pressure drop across the valve. The pressure taps shall have ½-inch extensions for accessibility.
 - e. Control valves shall be installed with unions or flanges as necessary for easy removal and replacement.
 - f. Valve Tag shall include the model number, AHU being served, design flow, and maximum flow for that valve.
 - g. The control valves shall be delivered preset to the scheduled design flow and should be capable of reaching 110% of the design flow to allow for field adjustment for capacity changes..
- D. Electric Actuators: Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable. For VAV reheat valves, actuators shall have a manual override capability to aid in system flushing, startup, and balancing.
- E. Air and Hot Water Electronic Temperature Sensors:
- 1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
 - 2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner's Representative.
 - 3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.
- F. Electronic Temperature Sensors and Transmitters:
- 1. Chilled Water, Tower Water, Heating Hot Water, and Steam Temperature Sensors
 - a. General: The RTD/Temperature Transmitter/Thermowell assembly shall come as a complete assembly from a single manufacturer. The Assembly shall be suitable for use in the accurate measurement of Chilled/Tower/Hot Water and steam temperatures in a mechanical room environment.

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- b. Calibration: Each RTD must be match calibrated to the Transmitter via NIST traceable calibration standards. Results are to be programmed into the transmitter. Results are to be presented on report as after condition at the specified calibration points. Assembly shall not be approved for installation until Owner has received all factory calibration reports.
- c. RTD:
- 1) RTD type: 2-wire or 3-wire 100 ohm platinum class A
 - 2) Outside Diameter: 0.25 inch
 - 3) Tolerance: +/- 0.06% Type A
 - 4) Stability: +/- 0.1 % over one year.
 - 5) TCR: 0.00385 (ohm/ohm/°C).
 - 6) RTD shall be tip sensitive.
 - 7) Resistance vs. Temperature table for the RTD must be provided to the Owner.
- d. Transmitter:
- 1) Transmitter shall be match calibrated to the RTD and assembled as a matched pair.
 - 2) Type: 2 wire (loop powered)
 - 3) Input: 2 or 3 wire 100 ohm platinum class A or class B RTD
 - 4) Output: Output shall be a 4-20 mA signal linear to temperature
 - 5) Calibrated Span:
 - a) Chilled Water: 30 °F to 130 °F.
 - b) Tower Water: 30 °F to 130 °F.
 - c) Hot Water: 100 °F to 250 °F.
 - d) Steam: 150 °F to 450 °F
 - 6) Calibration Accuracy, including total of all errors, of the Transmitter & RTD matched pair over the entire span shall be within +/- 0.2% of the calibrated span or +/- 0.18 °F, whichever is greater.
 - 7) Supply Voltage: 24 VDC.
 - 8) Ambient Operating Temp.: 32 to 122 °F
 - 9) Epoxy potted for moisture resistance.
 - 10) Mounting: Transmitter shall be mounted in the RTD connection head.
- e. Thermowell
- 1) Thermowell shall be suitable for immersion in chilled/hot water and steam.
 - 2) Thermowell shall be reduced tip.
 - 3) Thermowell shall be one piece stainless steel machined from solid bar stock.
 - 4) Thermowell shall have 1/2" NPT process connection to pipe thred-o-let.
 - 5) Thermowell Insertion depth shall be ½ the inside pipe diameter but not to exceed 10".
- f. Assembly:
- 1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.

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- 2) Connection head shall be cast aluminum with chain connecting cap to body, have 1/2" NPT process and 3/4" NPT conduit connections, and a sealing gasket between cap and body.
 - g. RTD/Temperature Transmitter/Thermowell assembly shall be the following or approved equal:
 - 1) Manufacturer: Pyromation, Inc.
 - 2) Chilled Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(30-130)F with calibration SMC(40,60)F
 - 3) Tower Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(5130)F with calibration SMC(55,85)F
 - 4) Hot Water: RAF185L-S4C[length code]08T2-SL-8HN31,TT440-385U-S(100-250)F with calibration SMC(140,180)F
 - 5) Steam: RAT185H-S4C[length code]08T2-SL-8HN31,TT440-385U-S(150-450)F with calibration SMC(300,350)F
 - G. Low Limit Controllers: Provide unit-mounted low limit controllers, of rod-and-tube type, with an adjustable set point and a manual reset. Capillary shall be of adequate length to horizontally traverse face of cooling coil every 12". Multiple low limit controllers may be required for large coils. Controller shall have an extra set of contactors for connection to control panel for alarm status. Locate the thermostat case and bellows where the ambient temperature is always warmer than the set point.
 - 1. Freeze Stats: Johnson Controls model A70HA-1 or approved equal.
 - H. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
 - 1. Kele, DCPA-1.2 or approved equal.
 - I. Pressure Differential Switch:
 - 1. Fans: NECC model DP222 or approved equal.
 - J. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
 - 1. Water: Units shall be wet/wet differential pressure capable of a bi-directional pressure range of +/- 50 psid. Accuracy shall be +/- 0.25% full scale with a compensated temperature range of 30 to 150 deg F and a maximum working pressure of 250 psig.
 - 2. Install transmitter in a pre-manufactured assembly with shut off valves, vent valves and a bypass valve.
 - a. Setra model 230 with Kele model 3-VLV, three valve manifold or approved equal.
 - 3. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig.
 - a. Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.

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- K. High Static Pressure Limit Switch: Provide pressure high limit switch to open contact in fan circuit to shut down the supply fan when the inlet static pressure rises above the set point. Provide with an adjustable set point, a manual reset button, 2 SPST (normally closed) contacts, and ¼" compression fittings.
1. Kele model AFS-460-DDS, or approved equal.
- L. AIRFLOW/TEMPERATURE MEASUREMENT DEVICES
1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
 2. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings calculated for each sensor housing shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.
 3. All Sensor Probe Assemblies
 - a. Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
 - b. Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use "chip" or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
 - c. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - 1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
 - d. The operating temperature range for the sensor probe assembly shall be -20° F to 160 F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
 - e. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15° F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - f. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
 - g. Each sensor assembly shall not require matching to the transmitter in the field.
 - h. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.

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4. Duct and Plenum Sensor Probe Assemblies
- a. Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly. Thermistor probes shall be mounted in sensor housings using a waterproof marine grade epoxy resin. All wires within the aluminum tube shall be Kynar coated.
 - b. The number of sensor housings provided for each location shall be as follows:
 - 1) Area (sq.ft.) Sensors
 - 2) <2 4
 - 3) 2 to <4 6
 - 4) 4 to <8 8
 - 5) 8 to <16 12
 - 6) >=16 16
 - c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
 - 1) Insertion mounted through the side or top of the duct.
 - 2) Internally mounted inside the duct or plenum.
 - 3) Standoff mounted inside the plenum.
 - d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.
5. Fan Inlet Sensor Probe Assemblies
- a. Sensor housings shall be mounted on 304 stainless steel blocks.
 - b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
 - c. Mounting feet shall be constructed of 304 stainless steel.
 - d. The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
6. Transmitters
- a. The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
 - b. The transmitter shall be capable of independently monitoring and averaging up to 16 individual airflow and temperature readings. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.
 - c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.

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- d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
 - e. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
 - f. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
 - 1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
 - 2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus.
 - 3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP.
 - 4) LonWorks Free Topology.
 - g. The transmitter shall have an infra-red interface capable of downloading individual sensor airflow and temperature data or uploading transmitter configuration data to a handheld PDA (Palm or Microsoft Pocket PC operating systems).
- 7. The measuring device shall be UL listed as an entire assembly.
 - 8. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.
 - 9. Manufacturer
 - a. Primary flow elements, sensors, meters and transducers shall be EBTRON, Inc. Model GTx116-P and GTx116-F or approved equal.
 - b. The naming of any manufacturer does not automatically constitute acceptance of this standard product nor waive their responsibility to comply totally with all requirements of the proceeding specification.
- M. Electrical Requirements: Provide electric-pneumatic switches, electrical devices, and relays that are UL-listed and of type which meet current and voltage characteristics of the project. All devices shall be of industrial/ commercial grade or better. Residential types will be rejected.
- 1. EP Switches: Landis & Gyr Powers, Inc. Series 265 - Junction Box Type or approved equal.
 - 2. Relays: Relays shall have an LED status indicator, voltage transient suppression, Closed-Open-Auto switch, plastic enclosure, and color coded wires. Kele model RIBU1C or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.

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- B. Control Air Piping:
1. All control air piping shall be copper. Exception: Flexible Tubing may be used for a maximum of two (2) feet at connections to equipment [except for steam control valves] and inside control cabinets.
 2. Provide copper tubing with a maximum unsupported length of 3'-0".
 3. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
 4. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
 5. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
 6. All control tubing at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel.
 7. Provide pressure gages on each output device.
 8. Paint all exposed control tubing to match existing.
- C. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.
- D. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
 2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
 3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
 - a. Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
 4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
 - a. Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
 5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.
- E. All low voltage electrical wiring shall be run as follows:
1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
 2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
 3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated and properly supported to building structure.

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4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.
- F. All devices shall be mounted appropriately for the intended service and location.
1. Adjustable thermostats shall be provided with base and covers in occupied areas and mounted 48" above finished floor to the top of the device. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owners Representative. Wall mounted sensors such as CO2, RH, and non-adjustable temperature sensors shall be mounted 54" above finished floor. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
 2. All control devices shall be tagged and labeled for future identification and servicing of control system.
 3. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
 4. All other air sensors located in AHU's shall be of adequate length to cover every 36" of the air flow path.
 5. All field devices must be accessible or access panels must be installed.
- G. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.
- H. Install disconnect switch that is field mounted on the face of AHU I/O panel. This switch shall provide the equivalent of a software point to enable and disable the unit from BAS. Switch shall have a plastic cover to prevent accidental use. Label switch to read "AH-XX BAS ENABLE/DISABLE AUTHORIZED USE ONLY". IDEC model ASD201NU 2-position selector switch (30mm) and IDEC OL-KL1 Lock out Adapter (Switch Cover) or equivalent.
- 3.2 ADJUSTING AND START-UP
- A. Start-Up: Temporary control of Air Handling Units shall be allowed only if approved by the owner's representative to protect finishes, etc., AHUs may be run using caution with temporary controls installed by contractor early in the startup process. All safeties including a smoke detector for shut down must be operational. Some means of discharge air control shall be utilized and provided by the contractor such as a temporary temperature sensor and controller located and installed by the Contractor.
- B. The start-up, testing, and adjusting of pneumatic and digital control systems will be conducted by owner. Once all items are completed by the Contractor for each system, Contractor shall allow time in the construction schedule for owner to complete commissioning of controls before project substantial completion. This task should be included in the original schedule and updated to include the allotted time necessary to complete it. As a minimum, the following items are required to be completed by the Contractor for Owner to begin controls commissioning.
1. Process Control Network
 - a. The control boards and enclosures need to be installed in the mechanical rooms.

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- b. The fiber optic conduit and box for the process control network needs to be installed. Once in place, Owner needs to be contacted so the length of the owner provided fiber cable can be determined and ordered, if required. Coordinate with Owner to schedule the pull in and termination of the fiber cable. Power should be in place at that time. (Fiber for the process control network is required to allow metering of utilities prior to turn on.)
- 2. Heating System
 - a. Pumps, heat exchangers, steam pressure reducing station, piping, control valves, steam and/or hot water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, steam regulators set to required pressure, condensate pumps operational, heating system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.
 - 3. Cooling System
 - a. Pumps, heat exchangers, piping, control valves, chilled water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, cooling system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.
 - 4. Air Handlers
 - a. Prior to owner commissioning, at a minimum, the following items shall be complete: Power wiring, motor rotation check, fire/smoke dampers open, control wiring including all safeties, IO cabinet, air handler cleaned, and filters installed as required. To protect the systems from dirt, outside air with no return will be used until the building is clean enough for return air operation.
 - 5. Some balance work can be done alongside the control work as long as areas are mostly complete and all diffusers are in place.
- 3.3 CLOSEOUT PROCEDURES
- A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.
 - B. Contractor shall provide as built diagram of network bus routing listing all devices on bus, once wiring is complete prior to scope completion.

END OF SECTION 230900

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SECTION 232100 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings
- B. Valves
- C. Check Valves
- D. Strainers
- E. System Piping Schedule

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

- A. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- B. ANSI/AWS D1.1 - Structural Welding Code.
- C. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- D. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- E. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- F. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.
- G. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- H. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.
- I. ASME - Boiler and Pressure Vessel Code.
- J. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- K. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

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- L. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
 - M. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - N. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
 - O. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
 - P. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
 - Q. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
 - R. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - S. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
 - T. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 - U. ASME B16.51 - Copper And Copper Alloy Press-Connect Pressure Fittings.
 - V. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
 - W. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
 - X. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
 - Y. ASME B31.9 - Building Services Piping.
 - Z. ASME Section 9 - Welding and Brazing Qualifications.
 - AA. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
 - BB. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
 - CC. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.
 - DD. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - EE. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - FF. ASTM A536 - Standard Specification for Ductile Iron Castings
 - GG. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
 - HH. ASTM B32 - Standard Specification for Solder Metal.
 - II. ASTM B88 - Seamless Copper Water Tube.

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- JJ. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - KK. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.
 - LL. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - MM. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.
 - NN. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.
 - OO. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
 - PP. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
 - QQ. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
 - RR. ASTM D2992 - Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.
 - SS. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.
 - TT. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
 - UU. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - VV. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.
 - WW. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.
 - XX. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
 - YY. ASTM E413-87 - Classification for Rating Sound Insulation
 - ZZ. ASTM F2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
 - AAA. ASTM F3226 - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.
 - BBB. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.
- 1.4 SUBMITTALS
- A. Submit product data under provisions of Section 230500. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 STEEL PIPE (ABOVE GRADE)

- A. Design Pressure 125 psig, Maximum Design Temperature 225°F (230°F for grooved couplings).
- B. Black Steel; Standard Weight; Threaded Joints:
 - 1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.
 - 2. Joints: Screwed.
 - 3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.
 - 4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.
- C. Black Steel; Standard Weight; Welded or Flanged Joints:
 - 1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
 - 2. Joints: Butt-welded or flanged.
 - 3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
 - 4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.
- D. Black Steel; Standard Weight; Welded:
 - 1. Design Pressure: 125 psi. Maximum Design Temperature: 1000°F
 - 2. Pipe: Standard weight black steel, beveled ends, ASTM A53.
 - 3. Joints: Butt welded.
 - 4. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.

2.2 VALVES

- A. Shutoff Valves:
 - 1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Ball Valves:

- a. BA-1 (Steel and Copper): 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.
 - 1) Body: Bronze of a copper alloy containing less than 15% zinc.
 - a) Manufacturers: Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB, Jomar T/S-200CSS.
 - 2) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping. (For example, Jomar modifies valve part number with -IH for insulated handle.)
 - 3) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim. (For example, Jomar modifies valve part number with -LH for locking handle.)

3. Butterfly Valves:

- a. BF-1:
 - 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 225°F continuous and 250°F intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze, stainless steel, or electroless-nickel coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size.
 - 2) Manufacturers:
 - a) Victaulic #300
 - b) Watts #DBF-03-121-1P
 - c) Nibco N200 Series or LD2000 Series
 - d) Milwaukee CL Series

2.3 LOCK OUT TRIM

- A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120°F and as indicated on the drawings.

2.4 CHECK VALVES

- A. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

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- B. CK-1: Check Valves (Steel Pipe); 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing.
 - 1. Manufacturers:
 - a. Crane #37
 - b. Milwaukee #509
 - c. NIBCO #T-413

2.5 STRAINERS

- A. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
- B. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F.
 - 1. Manufacturers:
 - a. Mueller Steam Specialty Co. #351
 - b. Sarco #BT
 - c. Watts #777
 - d. NIBCO T-221-A.
- C. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 353°F, 175 psi WOG @ 150°F.
 - 1. Manufacturers:
 - a. Mueller Steam Specialty Co.#758
 - b. Sarco #CI-125
 - c. Watts #77F-D
 - d. Victaulic #732 or #W732
 - e. NIBCO F-721-A.
- D. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:
 - 1. Pipe Size:
 - a. 1/4" - 2": 1/32" screen
 - b. 2-1/2" - 8": 1/16" screen
- E. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- F. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain-end ferrous pipe.

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- B. Remove scale and dirt on inside and outside before assembly.
 - C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
 - D. Connect to all equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
 - E. Flush and clean piping as defined below. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
 - F. After completion, fill, clean, and treat systems. Refer to Section 232500 for treatment.

3.2 SYSTEMS, PIPING, AND VALVE SCHEDULE

- A. Chilled Water (Above Grade):
 - 1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
 - 2. Black Steel; Standard Weight; Welded or Flanged Joints: 2-1/2" and Over
 - 3. Shutoff Valves: , BA-1, BF-1
 - 4. Check Valves: CK-1
 - 5. Strainers: ST-1, ST-2

3.3 TESTING PIPING

- A. Test pipes underground or in chases and walls before piping is concealed.
- B. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
- C. Test the pipe with water at 1.5 times the design pressure but not less than 125 psig pressure. Hold pressure for at least two hours.
- D. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

3.4 CLEANING PIPING

- A. Assembly:
 - 1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
 - 2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
 - 3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
 - 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.
4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 232500. The system shall not be allowed to sit empty for any length of time.
5. When system water is clear, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
6. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 232500, shall be repeated at the Contractor's expense.
7. Chemical cleaning applies to the following systems:
 - a. Chilled Water

3.5 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
6. Install bell and spigot pipe with bells upstream.
7. Seal pipes passing through exterior walls with a wall seal per Section 230529. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
3. Provide clearance for installation of insulation, and access to valves and fittings.
4. Prepare pipe, fittings, supports, and accessories for finish painting.
5. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
6. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
7. Provide flanges or unions at all final connections to equipment, traps and valves.
8. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
9. Horizontal swing check valves may only be installed in horizontal position. Do not install horizontal swing check valves in upward or downward flow direction. Where upward or downward flow installation is required, use spring-assisted, non-slam check valve.

3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. 2-1/2" and larger fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

3.8 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.

3.9 JOINING OF PIPE

- A. Threaded Joints (Steel Pipe):
 - 1. Ream pipe ends and remove all burrs and chips.
 - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
 - 3. Apply Teflon tape to male threads.
- B. Flanged Joints (Steel Pipe):
 - 1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
 - 2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
 - 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

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4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
- a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.
 - e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.
- C. Welded Joints (Steel Pipe):
- 1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
 - 2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
 - 3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
 - 4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

END OF SECTION 232100

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SECTION 232116 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Air Vents
- B. Balancing Valves

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Code.
- B. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- C. ASME B31.9 - Building Services Piping.
- D. ASME Section 9 - Welding and Brazing Qualifications.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings
- F. ASTM B32 - Standard Specification for Solder Metal.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 230500. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 230500 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 MANUAL AIR VENTS

- A. At end of main and other points where large volume of air may be trapped, use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- B. On branch lines and small heating units, use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.2 BALANCING VALVE

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units that sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:
 - 1. Carrying case with handle.
 - 2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.
 - 3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.
- D. Valves in copper piping shall be brass or bronze.
 - 1. Multi-Turn Style (Brass or Bronze):
 - a. Manufacturers:
 - 1) Tour&Anderson (STAD)
 - 2) Armstrong "CBV"
 - 3) Victaulic 786
 - 4) MEPCO MBV
 - 5) NIBCO 1710
- E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 230900 with a specified throttling valve.
 - 1. Multi-Turn Style (Ferrous Piping ≤ 2"):
 - a. Manufacturers:
 - 1) TA Hydronics "786-789"
 - 2) Armstrong "CBV"
 - 3) Victaulic 787
 - 4) MEPCO MBV

F. Balancing valves in ferrous piping over 2 size shall have flanged or grooved ends and steel or cast iron construction. Option to balancing valves noted above are flow sensor specified in Section 230900 with a specified throttling valve.

1. Multi-Turn Style (Ferrous Piping Greater Than 2"):

a. Manufacturers:

- 1) Armstrong "CVB-II"
- 2) Tour&Anderson (STAF, STAG)
- 3) Victaulic 788/789
- 4) MEPCO MBV
- 5) NIBCO 737

G. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.3 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron and steel connected to each other.
2. Brass, copper, and bronze connected to each other.
3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.
2. Manufacturers:
 - a. Elster Group ClearFlow fittings
 - b. Victaulic Series 647
 - c. Grinnell Series 407
 - d. Matco-Norca

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

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2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
 6. Manufacturers:
 - a. EPCO
 - b. Central Plastics
 - c. Pipeline Seal and Insulator
 - d. F.H. Maloney
 - e. Calpico

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves/Fittings and Accessories:

1. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.
2. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.
3. Prepare accessories for finish painting.
4. Install accessories with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
5. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
6. Provide flanges or unions at all final connections to equipment, traps and valves.
7. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

END OF SECTION 232116

SECTION 232200 - STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Steam Piping System.
- D. Condensate Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9.

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. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- D. ANSI/ASME B16.9 - Factory Made Wrought Steel Butt Welding Fittings.
- E. ANSI/ASME B31.1 - Code for Power Piping.
- F. ANSI/ASME B31.9 - Building Services Piping.
- G. ANSI/AWS D1.1 - Structural Welding Code.
- H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- I. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- J. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- K. ASTM E413-87 - Classification for Rating Sound Insulation.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 230500. Include data on pipe fittings, valves and accessories.

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- B. Include certification of compliance with ANSI/AWS D1.1 for all welders.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent corrosion and entrance of foreign matter.
- B. Deliver and store valves in shipping containers with labeling in place.

1.6 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9 for the following pipe systems:
 - 1. Boiler external pipe systems that operate up to 15 psi.
 - 2. Non-boiler external pipe systems that operate up to 150 psi.
- B. Conform to ANSI/ASME B31.1 for boiler external pipe systems that operate above 15 psi.
- C. Refer to ANSI/ASME B31.1 and ANSI/ASME B31.9 for "boiler external piping" and "non-boiler external piping" definitions.

PART 2 - PRODUCTS

2.1 STEEL PIPING (0 TO 125 PSIG)

- A. Steel Pipe; 0 to 125psig; Standard Weight; Threaded Joints:
 - 1. Design Pressure: 125 psig. Maximum Design Temperature: 353°F.
 - 2. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.
 - 3. Joints: Screwed.
 - 4. Fittings: 125 psi S - 175 psi. WOG, cast iron, ASTM A126, ANSI B16.4.
 - 5. Unions: 250 psi S - 500 psi. WOG, black malleable iron, ground joint with brass seat.
- B. Steel Pipe; 0 to 125psig; Standard Weight; Flanged Joints or Welded Joints:
 - 1. Design Pressure: 125 psig. Maximum Design Temperature: 353°F.
 - 2. Pipe: Standard weight black steel, beveled ends, ASTM A53.
 - 3. Joints: Butt welded or flanged.
 - 4. Fittings: Standard weight seamless steel, butt welded type, ASTM A234, Grade WPB, ANSI B16.9.
 - 5. Flanges: 150 lb. forged steel, welding neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Flange face seal weld (backweld) is required for slip-on flanges.
- C. Steel Pipe; 0 to 125psig; Extra Strong; Threaded Joints:
 - 1. Design Pressure: 125 psig. Maximum Design Temperature: 353°F.
 - 2. Pipe: Extra strong black steel, threaded and coupled, ASTM A53.
 - 3. Joints: Screwed.
 - 4. Fittings: 125 psi S - 175 psi WOG, cast iron, ASTM A126, ANSI B16.4.
 - 5. Unions: 250 psi S - 500 psi WOG, black malleable iron, ground joint with brass seat.
- D. Steel Pipe; 0 to 125psig; Extra Strong; Flanged Joints or Welded Joints:
 - 1. Design Pressure: 125 psig. Maximum Design Temperature: 353°F.

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2. Pipe: Extra strong black steel, beveled ends, ASTM A53.
 3. Joints: Butt welded or flanged.
 4. Fittings: Extra strong seamless steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.
 5. Flanges: 150 lb. forged steel, welding neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Welding neck type shall be used wherever possible and shall have bore to match pipe. Flange face seal weld (backweld) is required for slip-on flanges.

2.2 VALVES

A. Boiler/Shutoff Valves:

1. Gate Valves:

- a. GA-1 (0 to 125 psig): 2" and under, 125 psi S @ 353°F, 300 psi WOG @ 150°F, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131, Jomar T-351G.
- b. GA-2 (0 to 125 psig): 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, NIBCO F-617-O.
- c. GA-8 (126 to 250 psig): 2" and under, 800# steam, socket weld, forged steel, OS&Y, bolted bonnet. Vogt Valves SW11103.
- d. GA-4 (126 to 250 psig): 2-1/2" thru 12", 250 psi S @ 405°F, 500 psi WOG @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #7-1/2E, Hammond, Stockham, Walworth #W786F, Milwaukee #F2894, Watts, NIBCO F-667-O.

B. Shutoff Valves:

1. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.
 - a. Body: Bronze
 - 1) Manufacturers: Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB, Jomar T/S-200CSS.

2.3 CHECK VALVES

- A. CK-1 (0 to 125 psig): 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #3406, Milwaukee #509, NIBCO T-413-Y, Jomar T-511G.
- B. CK-6 (0 to 125 psig): 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, all iron, horizontal swing. Crane #373-1/2, Hammond #IR1126, Stockham #G933, Walworth #8928-1/2F, Milwaukee #F2971, Watts #F-511-R, NIBCO F-918-Ng.
- C. CK-3 (126 to 250 psig): 2-1/2" thru 12", 250 psi S @ 405°F, 500 psi WOG @ 150°F, flanged, iron body, bronze mounted, horizontal swing. Crane #39E, Hammond #IR322, Stockham #F947, Walworth #8970F, Milwaukee #F2970, Watts #F-569, NIBCO F-968-B.

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- D. CK-9 (126 to 250 psig): 2" and under, Class 800, socket weld, forged steel, lift type with bolted cover. Crane FB-3675XU-W, JME 24834SC.

2.4 STRAINERS

- A. ST-1 (0 to 125 psig): Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 400# WOG @ 150°F. Armstrong #CA1SC, Metraflex #TS, Mueller Steam Specialty Co. #11M, Sarco #IT, Watts #77S, NIBCO T-751. Bronze body strainer 125# may be used as contractor option.
- B. ST-2 (0 to 125 psig): Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 353°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F, NIBCO F-721.
- C. ST-5 (126 to 250 psig): Cast steel body, socket weld ends, screwed cover, 600# steam @ 850°F, 1440# WOG @ 150°F. Armstrong #B1SW, Mueller Steam Specialty Co. #862, Sarco #CT.
- D. ST-6 (126 to 250 psig): Cast steel body, 300# flanged ends, bolted cover, 300# steam, 720# WOG. Armstrong #B1FL, Mueller Steam Specialty Co. #762, Sarco #1738.
- E. Unless otherwise indicated, strainers shall have stainless steel screens with perforations as follows:
 - 1. Steam All Sizes: 1/32"
 - 2. Condensate All Sizes: 3/64"
- F. Furnish pipe nipple with gate valve and threaded cap to blow down all strainer screens.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- D. Make connections to equipment with flanges or unions.
- E. After completion, fill, clean, and treat systems.

3.2 PIPING SCHEDULE

- A. Steam (0 to 125 psig):
 - 1. Steel Pipe; 0 to 125 psig; Standard Weight; Threaded Joints: 2" and Under
 - 2. Steel Pipe; 0 to 125 psig; Standard Weight; Flanged Joints or Welded Joints: 2-1/2" and Over
 - 3. Shutoff Valves: GA-1, GA-2, BA-1 Check Valves: CK-1, CK-6
 - 4. Strainers: ST-1, ST-2

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- B. Condensate Piping (0 to 125 psig):
1. Steel Pipe; 0 to 125 psig; Extra Strong; Threaded Joints: 2" and Under
 2. Steel Pipe; 0 to 125 psig; Extra Strong; Flanged Joints or Welded Joints: 2-1/2" and Over
 3. Shutoff Valves: GA-1, GA-2, BA-1 Check Valves: CK-1, CK-6
 4. Strainers: ST-1, ST-2
- 3.3 Shutoff Valves: GA-1, GA-2, BA-1 Shutoff Valves: GA-1, GA-2, BA-1 TESTING PIPING
- A. Complete all testing of pipes underground, or in chases and walls, before piping is concealed.
 - B. Complete all testing before insulation is applied, or if insulation is applied before the pipe is tested and a leak develops which ruins the insulation, the pipe installing contractor shall arrange and pay for replacing the damaged insulation.
 - C. Test piping with water at 150% of the maximum operating pressure.
 - D. Hold pressure for at least two hours.
 - E. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.
- 3.4 CLEANING PIPING
- A. Assembly:
 1. Prior to assembly of pipe and piping components, all loose dirt, scale, oil and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice subject to the approval of the Architect/Engineer's representative. Chips and burrs from machinery or thread cutting operation shall be blown out of pipe before assembly. Cutting oil shall be wiped from internal and external surfaces.
 2. During fabrication and assembly, remove slag and weld spatter from both internal and external pipe joints by peening, chipping and wire brushing.
 3. Notify the Architect/Engineer's representative prior to starting any post erection cleaning operation in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Arrange for proper disposal of cleaning and flushing fluids.
 4. When system clean, remove, clean and replace all strainer screens (blowing down strainer without removing and cleaning screen is not acceptable).
 5. When the system is started up for the first time, discharge the condensate to drain per the boiler manufacturer's recommendations or for 24 hours, whichever is more restrictive. Add domestic cold water to the drain at a sufficient rate to reduce the condensate temperature to a maximum of 140°F.
- 3.5 INSTALLATION
- A. General Installation Requirements:
 1. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
 2. Install piping to conserve building space and not interfere with use of space, other work, or equipment.
 3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

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4. Slope steam piping 0.25" in 10 feet in direction of flow. Use eccentric reducers to maintain bottom of pipe level.
 5. Slope steam condensate piping 0.5" in 10 feet.
 6. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply zinc rich primer to welds.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Provide clearance for installation of insulation and access to valves and fittings.
2. Provide access doors where valves and fittings are not exposed.
3. Provide drip trap assembly at low points and before control valves and pressure reducing valves.
4. Provide loop vents over trapped sections.
5. Prepare pipe, fittings, supports, and accessories for finish painting.
6. Provide drip legs as shown on the drawings, at low points, traps, and the base of all risers in steam, and condensate pipes. Unless otherwise shown, drip legs shall be full pipe size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, with a reducer and a 3/4" shutoff valve.
7. Install valves with stems upright or horizontal, not inverted.
8. Provide shutoff valves in supply and return to all equipment.
9. Install strainers in steam piping with the "wye" of the strainer to the side of the pipe in the horizontal plane to avoid pooling of condensate.

3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied identification sufficient to determine conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of system. Use plugs, caps, blind flanges or other items designed for this purpose.
- E. Run pipe straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and to provide needed flexibility in piping.
- F. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be long radius type, unless otherwise noted.

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- G. Provide flanges or unions at all connections to equipment traps and valves to facilitate dismantling.
 - H. Arrange piping and connections so equipment served may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
 - I. Use full and double lengths of pipe wherever possible.
 - J. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size made only at control valve, pump, or trap.
 - K. Cut all pipe to exact measurement and install without springing or forcing.
 - L. Avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or building elements with piping connections or supports.
 - M. Unless otherwise indicated, branch takeoffs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for steam pipes.
 - N. Branch takeoffs shall be from the top, side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping for liquids.

3.7 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise indicated.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Branch connections from mains may be cut into black steel pipe using forged weld-on fittings:
 - 1. Steam.
 - 2. Condensate.
 - 3. Boiler Feedwater.
- D. Use of forged weld-on fittings is further limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch pipe is at least two sizes under main size.

3.8 JOINING OF PIPE

- A. Threaded Joints (Steel Pipe):
 - 1. Screw threads shall conform to ANSI B2.1 "Pipe Threads".
 - 2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
 - 3. Protect plated pipe and valve bodies from wrench marks.
 - 4. Apply high temperature, anti-seize thread lubricant to male threads.

B. Flanged Joints (Steel Pipe):

1. Steel flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting for services up to 399°F shall be ASTM A307, Grade B bolts and heavy hexagonal nuts. Bolting for services from 400°F to 790°F shall be ASTM A193, Grade B-7 with Grade 24 hexagonal nuts. Bolts and nuts shall conform to ANSI B18.2.1 "Square and Hex Bolts" or B18.2.2 "Square and Hex Nuts".
3. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts so those directly opposite are torqued in sequence.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Gaskets used in piping systems for saturated steam service shall be approved by manufacturer for use in saturated steam applications up to and including 150 psig.
 - c. Gaskets used for superheated steam applications and for saturated steam systems with operating pressures greater than 150 psig saturated steam shall be of the spiral wound "chevron" metallic type with flexible graphite filler by the following manufacturers:
 - 1) Flexitallic (LS Style CG)
 - 2) TEADIT (Style 913)
 - 3) Garlock (Flexseal Style RW)
 - 4) Lamons (SpiraSeal Style WR)
 - 5) Leader (Style LG-13)
 - d. Gaskets used for steam condensate service including, but not limited to, condensate return, boiler feedwater, and condensate transfer piping systems shall meet the following requirements:
 - 1) Maximum pressure rating of at least 2,000 psig.
 - 2) Maximum continuous temperature rating of at least 650°F.

C. Welded Joints (Steel Pipe, Conduit System, Stainless Steel Pipe):

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

END OF SECTION 232200

SECTION 232218 - STEAM AND STEAM CONDENSATE SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Steam Traps

1.2 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.
- B. Traps: Remanufactured traps are not acceptable.

1.3 REFERENCES

- A. ANSI/ASTM - Boilers and Pressure Vessels Code.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. AHRI 460 - Standard for Commercial and Industrial Humidifiers.
- D. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
- E. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 230500. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
- B. Submit schedule indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.
- C. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- D. Submit manufacturer's installation instructions.
- E. Submit operation and maintenance data.

PART 2 - PRODUCTS

2.1 STEAM TRAPS

- A. Furnish traps as scheduled on the drawings.

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- B. Type T-1: Inverted bucket type with thermic vent, 250 psig rated, cast iron body, side inlet and outlet, and all internal components constructed of stainless steel and renewable in-line.
1. Manufacturers (0-250 psig):
 - a. Armstrong Machine Works Series 800T
 - b. Spirax/Sarco Co., Inc. Type B
 - c. Hoffman Industrial Specialties Co. Series 600 T
- C. Type T-2: Thermostatic type with body and cap of cast brass, bronze bellows, stainless steel valve head and seat.
1. Manufacturers: (0-25 psig):
 - a. Spirax/Sarco Co., Inc. Type TD
 - b. Hoffman Industrial Specialties Co. Type C
- D. Type T-3: Float and thermostatic type, 125 psig rated, cast iron body; balanced pressure thermostatic air vent; stainless steel valve seat, float, brass valve mechanism, and side inlet and outlet.
1. Manufacturers: (0-125 psig):
 - a. Armstrong Machine Works Type A
 - b. Hoffman Industrial Specialties Co. Series H, C, or X
 - c. Spirax/Sarco Co., Inc. Type FT

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. General Installation Requirements:
1. Install specialties in accordance with manufacturer's instructions.
 2. Size traps to handle minimum of two and one-half times maximum condensate load of apparatus served, unless noted otherwise.
 3. All traps shall be minimum 3/4" size.
 4. Install traps with unions or flanges at both ends.
 5. Provide shutoff valve and strainer at inlet, and check valve and shutoff valve at discharge of traps.
 6. Provide minimum 10" long dirt pocket of same size as apparatus return connection between apparatus and trap, unless noted otherwise on drawings.
 7. Remove thermostatic elements from traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- B. Insulate steam and steam condensate specialties in accordance with Section 230716 - HVAC Equipment Insulation and Section 230719 - HVAC Piping Insulation.

END OF SECTION 232218

SECTION 233100 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized Ductwork
- B. Ductwork Reinforcement
- C. Ductwork Sealants
- D. Rectangular Ductwork
- E. Round and Flat Oval Ductwork
- F. Exposed Ductwork (Rectangular, Round, or Oval)
- G. Ductwork Penetrations
- H. Painting

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

- A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.
- D. ASHRAE - Handbook 2020 Systems and Equipment; Chapter 19 - Duct Construction.
- E. ASHRAE - Handbook 2021 Fundamentals; Chapter 21 - Duct Design.
- F. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- G. ASTM A90 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- H. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.
- I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- K. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

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- L. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 - M. ASTM E413-87 - Classification for Rating Sound Insulation.
 - N. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.
 - O. AWS D9.1M/D9.1 - Sheet Metal Welding Code.
 - P. IECC - International Energy Conservation Code (latest published edition)
 - Q. NADCA ACR 2002 - Assessment, Cleaning, and Restoration of HVAC Systems.
 - R. NADCA Standard 05 1997 - Requirements for the Installation of Service Openings in HVAC Systems.
 - S. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
 - T. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
 - U. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.
 - V. SMACNA - Air Duct Leakage Test Manual.
 - W. SMACNA - HVAC Duct Construction Standards.
 - X. SMACNA - Phenolic Duct Construction Standard 022.
 - Y. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.
 - Z. UL 181 - Factory-Made Air Ducts and Air Connectors.
 - AA. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors
 - BB. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.
 - CC. UL 1978 - Standard for Grease Ducts.
 - DD. UL 2221 - Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies.
- 1.3 SUBMITTALS
- A. Submit shop drawings per Section 230500.
 - B. Submit duct fabrication standards in compliance with SMACNA and these specifications. Clearly indicate metal gauges, reinforcement, and joining methods intended for use for each pressure classification. Furnish details of all common duct fittings and joint connections to be used on this project.
 - C. Duct Leakage Test Summary Report: Upon completion of the pressure test described in Part 3, the Contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

1.4 DEFINITIONS

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.
- C. Exterior Duct: Ductwork located outside the conditioned envelope including exposed ductwork above the roof, outside exterior walls, in attics above insulated ceilings, inside parking garages, and crawl spaces.
- D. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

1.5 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 230500 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.
- B. Duct drawings shall be at 1/4" minimum scale complete with the following information:
 - 1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
 - 2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
 - 3. Location and size of all duct access doors.
 - 4. Room names and numbers, ceiling types, and ceiling heights.
 - 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
 - 6. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND SUPPORTS

- A. Rectangular Duct - Single Wall:
 - 1. General Requirements:
 - a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
 - b. Transitions shall not exceed the angles in Figure 4-7.

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2. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:
- a. All ducts shall be cross-broken or beaded.
 - b. Snap lock seams are not permitted.
 - c. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:
 - 1) Type 1:
 - a) Description: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
 - b) Usage: Limited to 3,000 fpm and vane lengths 36" and under.
 - 2) Type 2:
 - a) Description: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
 - b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.
 - 3) Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):
 - a) Description: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.
 - b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.
 - 4) Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
 - 5) Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.
 - 6) Omitting every other vane is prohibited.
 - d. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Mitered elbows (with or without turning vanes) may not be substituted for radius elbows. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.
 - e. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
 - f. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

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- g. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.
 - h. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
 - i. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
 - j. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.
 - k. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
 - 2) Manufacturers:
 - a) Ductmate Industries - 25/35/45
 - b) Nexus
 - c) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.
 - l. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
 - 2) Flanges shall be 24-gauge minimum (not 26 gauge).
 - 3) Manufacturers:
 - a) Lockformer TDC
 - b) TDF
 - c) United McGill
 - d) Sheet Metal Connectors
 - e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

- 1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

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2. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
 3. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
 4. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
 5. Ductwork shall be suitable for velocities up to 5,000 fpm.
 6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
 7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
 8. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
 9. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
 10. Transverse Joint Connections:
 - a. Crimped joints are not permitted.
 - b. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
 - c. Ducts and fittings larger than 36" shall have flanged connections.
 - d. Secure all joints with at least 3 sheet metal screws before sealing.
 - e. Manufacturers, Slide-on Flanges:
 - 1) Ductmate Industries - SpiralMate
 - 2) Accuflange
 - 3) Sheet Metal Connectors are acceptable.
 - f. Manufacturers, Self-Sealing Duct Systems:
 - 1) Lindab
 - 2) Ward "Keating Coupling"

C. Hangers and Supports General Requirements:

1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
2. Strap Hangers: Strap hanger shall be a minimum of 1 inch, 18 gauge attached to the bottom of ducts.
3. Cable Hangers:
 - a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.
 - b. Manufacturers; Supports:
 - 1) Gripple
 - 2) Ductmate
 - 3) Duro Dyne

4. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs. Install per manufacturer's ratings and instructions.

a. Manufacturers; Supports:

1) EZ Hanger

2.2 MATERIAL AND APPLICATION SPECIFIC

A. Galvanized Steel:

1. General Requirements:

- a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
- b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
- c. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
- d. Ductwork reinforcement shall be of galvanized steel.

2. Duct Hangers and Support Material:

- a. Ductwork hangers and supports shall be of galvanized or painted steel.
- b. All fasteners shall be galvanized or cadmium plated.

B. Duct Hangers and Support Material:

- 1. Ductwork hangers and supports shall be of galvanized or painted steel.
- 2. All fasteners shall be galvanized or cadmium plated.

C. Phenolic Non-Fibrous Closed Cell Ductwork - Outdoor:

1. Closure Materials:

- a. Duct system shall be connected and sealed per manufacturer's recommendations to meet the leakage, pressure class, and velocity noted within these specifications.

2. Install hangers and supports per manufacturer's recommendations.

D. PVC Coated Ductwork:

- 1. Ductwork reinforcement shall be of galvanized steel. All ductwork reinforcement shall be external.
- 2. Ductwork supports shall be of galvanized or painted steel. Supports shall not require penetrations of the PVC coating. Slip cable hangers are acceptable.

a. Manufacturers, Supports:

1) Gripple

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- E. Exposed Ductwork (Rectangular, Round, and Flat Oval):
1. The following applies to all ductwork exposed in finished areas in addition to requirements noted above:
 - a. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.
 - b. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.
 - c. Remove all identification stickers and thoroughly clean exterior of all ducts.
 - d. Locate fitting seams on least visible side of duct.
 - e. Provide exterior finish suitable for field painting without further oil removal.
 - f. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct.
 - g. Manufacturers, Slide-on Flanges:
 - 1) Ductmate Industries
 - 2) Accuflange
 - 3) Sheet Metal Connectors
 - h. Manufacturers, Self-Sealing Duct System:
 - 1) Lindab
 - 2) Ward "Keating Koupling"
 - i. The system shall be free of visible dents and scratches when viewed from normal occupancy.
 - j. All insulation shall be internal, except at reheat coils.
 2. In addition to the paragraphs above, this section applies to all ductwork specified or shown as "Architecturally Exposed":
 - a. All spiral ductwork fittings shall be carbon arc welded.
 - b. Grind all welds to remove irregularities.
 - c. Conical taps shall be one piece. Taps for grilles and takeoffs shall be factory installed with a continuous weld and ground smooth.
 - d. Welds shall be ground smooth and painted.
 - e. All architecturally exposed ducts shall be round or flat oval except where not possible (grilles, reheat coils, etc.).
 3. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:
 - a. Metal gauge of duct and fittings.
 - b. Fitting type and construction.
 - c. Type and size of reinforcement.

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4. Hangers for Exposed Ductwork:
- a. Round Ducts:
 - 1) Threaded rod with duct fixing bracket and metal strap. Provide single threaded rod centered on the duct. Strap hanger shall be a minimum of 1 inch, 18 gauge galvanized steel wrapping the circumference of the duct. Spacing as required by SMACNA guidelines.
 - 2) Aircraft cable with 2-point support in standard horseshoe arrangement.
 - b. Rectangular Ducts:
 - 1) Aircraft cable and slip cable hangers are acceptable for ducts up to 18" in maximum dimension. Corner saddles are required when supporting rectangular ductwork. Spacing and cable size as required by SMACNA guidelines.
 - a) Manufacturers, Supports: Gripple, Ductmate, Duro Dyne, Architect/Engineer approved.
 - 2) Aircraft cable with 2-point support in standard horseshoe arrangement. Corner saddles are required when supporting rectangular ductwork.
 - c. Strut-channel and all-thread rod is not acceptable for exposed ductwork.
 - d. All fasteners shall be galvanized or cadmium plated.

2.3 DUCTWORK REINFORCEMENT

- A. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.
 - 1. Ducts must be over 18" wide.
 - 2. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
 - 3. Tie rods must not exceed 1/2" diameter.
 - 4. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.4 DUCTWORK SEALANTS

- A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.
- B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes.

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- C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.
- D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.
- E. Supply ductwork shall be free of construction debris, and shall comply with Level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- F. Repair all duct insulation and liner tears.
- G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.
- H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 230550 for seismic requirements.
- L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.
- M. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

3.2 DUCTWORK APPLICATION SCHEDULE

- A. Refer to Ductwork Application Schedule below for specific requirements for system, material, shape, pressure class, seal class and insulation application.

B. AHU Supply Duct:

1. Shape: Round and Flat Oval Spiral Seam Ductwork - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: +6"+
4. Seal Class: A
5. Insulation: 1-1/2" (40 mm) thick Type A (R=4.5)

6. Additional Requirements: Paint grade vapor barrier

C. Return Duct:

1. Shape:
 - a. Rectangular Duct - Single Wall
 - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall

2. Material: Galvanized Steel
3. Pressure Class: -4"
4. Seal Class: A
5. Insulation: 1" (25 mm) thick Type C (R=3.6)
6. Additional Requirements: None

3.3 SPECIAL INSULATION REQUIREMENTS

A. Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.):

1. Insulation:
 - a. ASHRAE 90.1-2022: 1-1/2" thick Type A (R=4.5)
 - b. IECC-2021: 1-1/2" thick Type A (R=4.5)

3.4 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

- B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

3.5 TESTING

A. Interior Duct - Less than 3" WG (positive or negative):

1. Leak testing of these pressure classes is not normally required for interior ductwork (inside the building envelope). However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:
 - a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
 - b. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
 - c. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
 - d. All joints shall be felt by hand, and all discernible leaks shall be sealed.
 - e. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
 - f. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
 - g. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
 - h. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
 - i. Positive pressure leakage testing is acceptable for negative pressure ductwork.

3.6 DUCTWORK PENETRATIONS

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.
- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

3.7 PAINTING

- A. Paint exterior of supply ducts flat black to match existing finish.

END OF SECTION 233100

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SECTION 237323 - ROOF MOUNTED AIR HANDLING UNIT REFURBISHMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Refurbishment of Existing Roof Mounted Air Handling Unit

1.2 QUALITY ASSURANCE

- A. Fabrication of units shall conform to AHRI 430, ASHRAE/ANSI Standard 111 and SMACNA - HVAC Duct Construction Standards.
- B. Unit components shall have a flame spread index of not over 25 and a smoke developed index of not over 50 per ASTM-E84; NFPA-255 and UL-723.
- C. Adhesives, sealants, tapes, insulations, vapor retarders, films, and other supplementary materials added to ducts and AHUs shall have flame spread/smoke developed ratings not over 25/50 per ASTM E84, NFPA 255, or UL 723.
- D. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. AHRI 430 - Standard for Central-Station Air-Handling Units.
- C. ASHRAE/ANSI Standard 111 - Practices for Measurements, Testing, Adjusting and Balancing Heating, Ventilating, Air-Conditioning and Refrigeration Systems.
- D. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- E. ASTM A167 - Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.
- F. ASTM A500-03a Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- G. ASTM A568 - Standard Specification for Steel Sheet, Carbon, and High Strength Low-Alloy, Hot-Rolled and Cold-Rolled.
- H. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- I. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.
- J. ASTM B429A - Standard Specification for Aluminum Alloy Extruded Structural Pipe and Tubing.

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- K. ASTM D-3359-B - Standard Test Methods for Measuring Adhesion of Coatings by Tape Test.
 - L. ASTM E-84 - Surface Burning Characteristics of Building Materials.
 - M. ETL - Electrical Testing Lab (Intertek Testing Service).
 - N. NEMA - National Electrical Manufacturers Association
 - O. NFPA 70 - National Electrical Code.
 - P. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
 - Q. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
 - R. SMACNA - HVAC Air Duct Leakage Test Manual.
 - S. SMACNA - HVAC Duct Construction Standards (latest edition).
 - T. UL 1995 - Heating and Cooling Equipment.
 - U. UL 723 - Surface Burning Characteristics of Building Materials.
- 1.4 SUBMITTALS
- A. Submit shop drawings per Section 230500.
 - B. Indicate metal gauges, material finishes, assembly, construction details, and field connection details including the following:
 - 1. Unit electric characteristics with connected load.
 - 2. Construction details and material finishes.
 - 3. Cooling coil performance data.
 - C. Any exceptions to the specifications must be clearly noted to the Engineer prior to acceptance. Contractor is responsible for all expenses due to exceptions.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. Deliver products to site with protective coverings in-place. Loose shipped items must be in factory-provided protective coverings, with factory-installed shipping skids and lifting lugs.
 - B. Store unit in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- 1.6 REGULATORY REQUIREMENTS
- A. Conform to NFPA 70, 90A, and 90B.
 - B. Unit shall contain only UL listed components.

1.7 WARRANTY

- A. Provide a parts and labor warranty against factory defects in material and workmanship for the components and coatings for a period of 1 year after refurbishment.
- B. Provide five-year material and labor warranty on interior and exterior paint systems of unit.

1.8 GENERAL DESCRIPTION

- A. Unit Location:
 - 1. The air handling unit is a constant volume, unit located on the roof.
 - 2. The unit will be set on a roof curb by the Contractor.
- B. Unit Description:
 - 1. The unit shall contain all the components as described in these specifications and as shown on the drawings and schedules.
 - 2. Refer to air handling unit drawings and schedules for additional information.

PART 2 - PRODUCTS

2.1 INTERNAL COMPONENTS

- A. Motors:
 - 1. Provided and installed by mechanical contractor. Refer to Section 230513 for requirements.
- B. Air Coils:
 - 1. Provided and installed by mechanical contractor. Refer to Section 238216 for requirements.
 - 2. Replace existing drain pan and drain connection for the cooling coil. Fabricate drain pan from 16 gauge stainless steel. Install a drain pan under the cooling coil per ASHRAE 62.1. Extend drain pan the entire width of the each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pan in two directions towards the outlet, with a slope of at least 1/8" per foot. Pipe drain pan individually to roof drain.
 - 3. Mechanical Contractor shall design and provide 304 stainless steel structure to support cooling coils. Structure shall be arranged such that any individual coil may be removed through the face of the structure without affecting the other coils or cutting/removal of housing panels.
 - 4. Mechanical Contractor shall insulate the underside of all drain pans, except those integral with the floor, with a minimum of 3/4" cellular flexible elastomeric foam sheet (Type E).
- C. Filters:
 - 1. Mechanical Contractor shall refurbish the filter section blank off panels so section is airtight.
 - 2. Install new MERV 8 filters to match existing after unit is reinstalled.

2.2 AHU EXTERIOR HOUSING REFURBISHMENT

A. Description:

1. Primer: Tnemec Series N69 High-Build Epoxoline II applied at 2.0-4.0 mils DFT.
2. Finish: Tnemec Series 1070 Fluoronar applied at 2.0-3.0 mils DFT. Color as directed by the Architect

B. Preparation: Mask off name plates, interior side of louvers and other items not requiring refinishing. Wash surfaces with mild detergent and hot water. Solvent clean entire housing and components. Sand all areas to be finished. Treat bare metal with conditioner or etching primer. Prepare substrate in accordance with SSPC-SP 16 with a minimum angular profile of 1.5 mils. A test patch is recommended to ensure proper adhesion to the substrate.

C. Finishing: Finish per manufacturer's instructions.

2.3 AHU INTERIOR HOUSING REFURBISHMENT

A. All internal surfaces of roof mounted AHU shall be provided with a multi-step treatment to extend longevity of the casing and associated parts. Treatment shall be specifically designed to stop water leaks and restore structural integrity within air handling unit systems. Process shall generally be as follows:

1. Existing cooling coil, drain pan, piping, and associated appurtenances shall be demolished by the Contractor as shown on the demolition drawings.
2. Contractor to modify structural base as required to support new equipment and appurtenances, including patching and sealing all areas where the casing was touched.
3. New coil, piping, drain pan, and associated appurtenances to be installed by the Contractor as shown on the drawings.
4. Coating contractor shall then perform their scope of work, including:
 - a. Isolating the AHU by sealing off all adjacent ductwork.
 - b. Cleaning and preparing all surfaces that will be treated with new coating, including the removal of rust, foams, and non-compliant coatings.
 - c. Reinforcing any remaining compromised surfaces in AHU casing to restore structure.
 - d. Applying coating to floors, interior wall surfaces, and interior ceiling surface of AHU.
 - e. Confirming proper operation of drains and traps.
 - f. Providing a detailed installation report.

B. Coating for floor shall be a 3-part solution, including a self-leveling epoxy, fire barrier covering the entirety of the epoxy layer, and an antimicrobial topcoat covering the entirety of the fire barrier. Epoxy layer shall extend no less than 6" up the walls throughout all chamber floors, including the outdoor air sheetmetal plenum.

C. Wall/ceiling coating to be a multi-acrylic, corrosion resistant, antimicrobial coating. Coating to cover all walls, ceilings, exposed structural steel, and fan housings within AHU. Coating to be compatible with any exposed internal liner within AHU.

D. Coatings shall not have any detectable odors or VOCs within 24 hours of installation.

E. Coating contractor shall include an extended 10-year non-prorated warranty for the work provided, which shall cover all parts and labor.

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- F. Coating shall be provided by AQUIS, no substitutions. Contact Jillian Hedenschoug (jhedenschoug@aquissolutions.com by email or 773-571-3450 by phone) for a proposal for the work above.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITIES

- A. General Installation Requirements on Site:
1. Verify that roof is ready to receive work.
 2. During construction provide temporary closures of metal or taped polyethylene over openings into housing ducts to prevent dust from entering ductwork.
 3. Control panels, conduit, piping, or equipment may not be mounted on the exterior of the housing walls or roof without prior approval of Architect/Engineer and unit manufacturer.
 4. Seal all contractor installed penetrations airtight. Seal all openings prior to cleaning. Seal holes with proper SMACNA closures conforming to pressure class of the housing.
- B. General Installation Requirements for Equipment:
1. Install clean filters in unit at final completion.
 2. Install all items in accordance with manufacturer's instructions.
 3. Clean dust and debris from each section of housing after it is installed. Clean inside of fan housings, fan scrolls, and coils of all units.
 4. Do not damage lining or devices in process of cleaning. Replace any damaged material.
 5. When installing field installed components (piping, electrical, etc.), Contractor shall protect manufacturer installed finishes (i.e., epoxy coating, etc.). If any damage occurs, the Contractor shall repair finishes as required to match existing finishes per manufacturer's recommendations.
- C. Internal Coil Piping Supports:
1. Install piping supports for field installed piping inside air tunnel. Supports shall not penetrate unit floor.
 2. Stands shall have U-shaped shields or saddles for piping sized to allow insulation to pass through continuous. Refer to Pipe Insulation for additional information.
 3. Stands shall have 12"x12" base plate and not be anchored to flooring. Coordinate placement of supports with unit manufacturer floor steel structure. Stands shall be located over structural supports unless approved otherwise by manufacturer.
 4. Stands shall have means for vertical adjustment.
 5. Stand in wet locations, including inside air handling units, shall be hot-dip galvanized.

END OF SECTION 237323

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SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Coils.

1.2 REFERENCES

- A. ANSI/AHRI 410 - Forced-Circulation Air Cooling and Air Heating Coils.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. ANSI/UL 1096 - Electric Central Air Heating Equipment.
- D. SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 230500.
- B. Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- C. Submit manufacturer's installation instructions.
- D. Submit manufacturer's data showing that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- B. Protect coils from entry of dirt and debris with pipe caps or plugs.
- C. Protect coolers from dirt and debris.

PART 2 - PRODUCTS

2.1 CHILLED WATER COILS

- A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.
- B. Stainless steel casing.
- C. Maximum air velocity of 480 fpm.
- D. Minimum water velocity in tubes of 3.2 fps. This is to prevent laminar flow at part load.

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- E. AHRI rated with 0.0005 tube side fouling factor.
 - F. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. The leaving DB, leaving WB, APD and WPD shall not exceed the scheduled values.
 - G. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.
 - H. Headers and pipe connectors shall be copper or brass for use in copper piping systems, or cast iron with ferrous pipe connectors for use in steel piping systems. If header material does not match the piping material, use dielectric fittings at the change in material.
 - I. All duct coils shall be installed in watertight duct sections with drains per SMACNA Fig. 2-11. Coil sections shall have slip and drive connections, and sufficient clearance for removal from ducts.
 - J. Coils shall have valved drain and vent connections at supply and return headers. Install coils level for proper drainage. Coils shall be completely drainable at the header.
 - K. |Suitable for 200 psig operation.
 - L. Turbulators are not permitted unless tube velocities are below 4 FPS at design flow or noted otherwise.
 - M. Coils shall have 5/8 tubes.
 - N. Minimum 0.025" tube wall thickness.
 - O. Manufacturers:
 - 1. Heatcraft
 - 2. Coilmaster
 - 3. Pace
 - 4. Approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install coils in accordance with manufacturer's instructions. Pipe coils with air flow and water flow in opposite directions (counter flow).
 - 2. Protect coils to prevent damage to fins and flanges.
 - 3. Make connections to coils with offsets and unions or flanges to allow coil to be removed without disturbing valves.
 - 4. Comb all coils to repair bent fins.

B. Cooling Coil:

1. Provide drain pan and drain connection for all cooling coils. Fabricate drain pan from 16 gauge stainless steel. Install a drain pan under cooling coil per ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot. Pipe drain pans individually to floor drain. Extend drain pan under header. Insulate all exterior surfaces of the drain pan in contact with the airstream with 1/2" elastomeric foam insulation with all seams sealed air tight.

END OF SECTION 238216

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SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 270528. This section is also applicable to Fire Alarm and Detection Systems Section 283100.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)

1.3 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. Separate contracts will be awarded for the following work.
- D. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- E. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- F. Description of Systems shall be as follows:
 - 1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
 - 2. Grounding system.
 - 3. Fire alarm system.
 - 4. Security system.
 - 5. Wiring system for temperature control system as shown on the drawings.
 - 6. Lightning protection system.
 - 7. Wiring of equipment furnished by others.
 - 8. Removal work and/or relocation and reuse of existing systems and equipment.
 - 9. Telecommunications rough-in, as shown on drawings, for installation of telecommunications equipment by others under separate contract.
 - 10. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

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- G. Work Not Included:
1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.
- 1.4 OWNER FURNISHED PRODUCTS
- A. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
 - B. This Contractor shall make all electrical system connections shown on the drawings **or** required for fully functional units.
 - C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.
- 1.5 WORK SEQUENCE
- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.
 - B. Itemize all work and list associated hours and pay scale for each item.
- 1.6 ALTERNATES
- A. Lightning Protection System.
- 1.7 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS
- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
 - B. Definitions:
 1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
 2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
 3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
 4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.

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5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
 6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
 7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
 8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
 9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.
 10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Luminaires.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical bus duct.
 - d. Sheet metal.
 - e. Cable trays, including access space.
 - f. Other piping.
 - g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".
2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.

3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.
4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the telecommunications ground bar.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.8 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

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2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
 3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

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4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.9 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Missouri Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of University of Missouri.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.

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4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
 5. Pay all charges arising out of required inspections by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
 7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
 8. Pay all telephone company charges related to the service or change in service.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.
8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.
9. Any item listed as furnished shall also be installed unless otherwise noted.
10. Any item listed as installed shall also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

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7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
 8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.10 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.11 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
26 05 13	Wire and Cable
26 05 26	Grounding and Bonding
26 05 33	Conduit and Boxes
26 05 53	Electrical Identification
26 27 26	Wiring Devices
26 28 16	Disconnect Switches
26 41 00	Lightning Protection Equipment
26 51 19	LED Lighting
28 31 00	Fire Alarm and Detection Systems
Drawings	Photocells, Timeclocks, Relays

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- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
 3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:

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- 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
- e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal, excluding mailing.

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16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 26 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 26 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.12 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.

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4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
- a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.
 - b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
 - c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
 - d. Fire alarm broken down into material and labor for the following:
 - 1) Engineering
 - 2) Controllers, devices, sensors, etc.
 - 3) Conduit
 - 4) Wiring
 - 5) Programming
 - 6) Commissioning
 - e. Site utilities (5' beyond building)
 - f. Seismic design
 - g. Testing
 - h. Commissioning
 - i. Record drawings
 - j. Punchlist and closeout

D. Update Schedule of Values when:

- 1. Indicated by Architect/Engineer.
- 2. Change of subcontractor or supplier occurs.
- 3. Change of product or equipment occurs.

1.13 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.14 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

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1. Distribution equipment - branch panels, distribution panels, switchboards, motor control centers, etc.
 2. Variable frequency drives.
 3. Transformers, ventilated.
 4. Electronic equipment, UPS, harmonic filters, power factor correction.
 5. Lighting luminaires and lighting control systems.
- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all materials clean, dry and free from damaging environments.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.
- 1.15 NETWORK / INTERNET CONNECTED EQUIPMENT
- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- B. The following network connected equipment shall be equipped with restricted access protocols:
1. Adjustable trip overcurrent protection devices
 2. Power monitoring and control
 3. Electrical controls
 4. Lighting control system
 5. Variable frequency drives
 6. Package engine generator and remote annunciator
 7. Transfer switch and remote annunciator
 8. Static uninterruptible power supply (UPS)
 9. Fire alarm and automatic detection
- 1.16 WARRANTY
- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.

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- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
 - C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.17 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.18 CONTINGENCY

- A. Include in the Base Bid a contingency of 10 percent to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.19 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.
- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

1.20 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

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6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
 8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.
 9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.
 10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
 11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
 12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand and/or CA6 for backfilling.
3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.
4. Dispose of the excess excavated earth as directed.
5. Backfill materials (native soil material, sand, and/or CA6) shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.

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9. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.
 10. Backfill with native soil material (if approved) or sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.
 11. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.
 12. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
 13. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. All junction boxes are closed and identified in accordance with Section 260553 Electrical Identification.
 - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
 - c. Luminaire whips are supported above the ceiling.
 - d. Conduit identification is installed in accordance with Section 260553 Electrical Identification.
 - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
 - f. All wall penetrations have been sealed.

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2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

3.4 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. IDPH Pre-Occupancy Requirements:
 1. Each Contractor must submit all forms and certifications required by IDPH relating to their work at 85% completion of the project or when directed by the Owner/Architect/Engineer.
- C. Final Jobsite Observation:
 1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
 3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
- D. The following must be submitted before Architect/Engineer recommends final payment:
 1. Operation and maintenance manuals with copies of approved shop drawings.
 2. Record documents including **[marked-up][or][reproducible]** drawings and specifications.
 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.
 4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to **[project site][and place in location as directed]** and submit receipt to Architect/Engineer.
 5. Inspection and testing report by the fire alarm system manufacturer.
 6. Start-up reports on all equipment requiring a factory installation or start-up.
- E. Circuit Directories:
 1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div26.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copies of all factory inspections and/or equipment startup reports.
5. Copies of warranties.

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6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 7. Dimensional drawings of equipment.
 8. Detailed parts lists with lists of suppliers.
 9. Operating procedures for each system.
 10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 11. Repair procedures for major components.
 12. Replacement parts and service material requirements for each system and the frequency of service required.
 13. Instruction books, cards, and manuals furnished with the equipment.
 14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.
 15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by **FACTORY PERSONNEL** in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. The instructions shall include:
 1. Maintenance of equipment.
 2. Start-up procedures for all major equipment.
 3. Description of emergency system operation.
- F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- G. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- H. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

3.8 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.

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- G. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.
 - H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.
- D. Raceway and Cable Routing Restrictions: Raceways and cable are restricted from being routed in the following locations, unless serving the space or permitted by the authority having jurisdiction.
 - 1. Elevator machine rooms and hoistways.
 - 2. Exit enclosures.
 - 3. Other areas restricted by code.
 - 4. Technology, data, server rooms.
 - 5. Fire pump and sprinkler rooms.
 - 6. Normal power in emergency power equipment rooms: Limited to feeders and branch circuits serving the emergency power equipment located in the room.
 - 7. Emergency power in normal power equipment rooms: Limited to feeders and branch circuits serving the normal power equipment located in the room.

3.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Within the Limits of Construction:
 - 1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.

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2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.
- B. Outside the Limits of Construction:
1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
 2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.
- C. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
1. General Contractor shall erect and maintain dust barriers throughout the construction work. These barriers shall be reasonably airtight and shall prevent entry into the construction zone by unauthorized persons. Reasonably airtight means construction equivalent to full-height temporary or permanent walls with joints taped or sealed, and shafts and other penetrations sealed as well as possible. Fire resistant polyethylene is acceptable; if flame spread/smoke developed ratings are demonstrated to conform to the applicable building codes and licensing acts.
 2. The Contractor shall continuously maintain the construction zone under a negative pressure of at least 0.01" w.g. minimum relative to all adjacent areas of the building.
 - a. Exhaust fans used for this purpose shall filter air and discharge it outdoors or to the least populated area adjacent to the construction work using negative air machines designed specifically for this purpose. All filtration for air recirculated back into the building shall be HEPA (99.97% DOP efficiency) for work adjacent to healthcare or elderly facilities. If no work is adjacent to these areas, 95% filtration is acceptable. Filtering air discharged to outdoors shall be accomplished with 30% filters.
 - b. If air is discharged outdoors, maintain all required distances to doors, windows, air intakes, etc.
 - c. If high levels of Volatile Organic Compounds (VOC's) or odors are released, activated carbon or equivalent filtration shall also be employed. Exhaust shall not discharge near doors, air intakes, pedestrians, gathering areas, or operable windows.
 - d. Adjusting existing air handling equipment to assist in pressure control is acceptable, if approved by the Owner and the authority having jurisdiction.
 - e. Seal return, exhaust, and supply air openings in or near the construction zone that serve existing air handling systems, and rebalance the systems for proper operation. If this is impractical, add filters at the intakes of sufficient cross sectional area to minimize the pressure drop and avoid the need for rebalancing.
 - f. Maintain pressure control one hour before and after all construction periods, and 24 hours per day in healthcare or elderly facilities.
 3. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.

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- c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 4. Request that the Owner designate an IAQ representative.
 5. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
 6. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
 7. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
 8. Request copies of and follow all Owner's IAQ and infection control policies.
 9. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
 10. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
 11. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings under Construction".

3.12 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.13 FIELD QUALITY CONTROL

- A. General:
 1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
 3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
 4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

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5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
 6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)
2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain.
3. If the ground resistance value obtained is more than the value set forth in Section 260526, the following shall be done to obtain the value given:
 - a. Verify that all connections in the service ground system are secure.
 - b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.
 - c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.
 - d. Review results with the Architect/Engineer.
4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:
 - a. Date of test.
 - b. Number of hours since the last rain.
 - c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.
 - d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.
 - e. Make, model, and calibration date of test equipment.
 - f. Tabulation of measurements taken and calculations made.

C. Ground-Fault Equipment Performance Testing:

1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:
 - a. Service disconnects
 - b. Solid state molded case circuit breakers and solid-state insulated case circuit breakers equipped with ground fault protection.
 - c. Fusible switches with ground fault relay protection.
 - d. Outside branch circuits and feeders.
 - e. Code required.

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2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.
- D. Arc Energy Reduction Equipment Performance Testing:
1. Test: Perform arc energy protection performance testing when system is installed. The test process shall use primary current injection or approved method per manufacturer instructions and procedures. Perform test for the following:
 - a. All arc energy reduction systems installed.
 2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.
- E. Other Equipment:
1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.
- F. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.
- G. Contractor shall thermographic study all electrical gear, switchboard, panelboards, etc. at the end of construction to identify any unusual conditions/heating within the equipment. Coordinate with Owner/Architect/Engineer to have an Owner/Architect/Engineer representative present during testing.
- H. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.
- I. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for "benchmark" amperages.
- 3.14 UTILITY REBATE
- A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.
 - B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 260500, cable insulation test results have been submitted.
5. Per Section 260500, medium voltage testing report has been submitted.
6. Per Section 260500, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 260500.
8. Bound copies of approved shop drawings have been submitted as per Section 260500.
9. Report of instruction of Owner's representative has been submitted as per Section 260500.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 260500.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION 260500

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SECTION 260505 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
- B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
- C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
- G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

3.2 PREPARATION

- A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.
- B. Coordinate utility service outages with Utility Company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
- D. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.
- E. Existing Electrical Service: Maintain existing system in service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Service changeover shall be completed on an overtime basis.
- F. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Provide a watchman to make required premise observations during all outages, requirements as dictated by codes and Owner's insurance carrier.
- G. Existing Telephone System: Maintain existing system. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. System changeover shall be completed on an overtime basis.
- H. Existing Lightning Protection System: Maintain existing system in service. Disable system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. System downtime shall occur on an overtime basis.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.
- D. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

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- E. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.
 - F. Disconnect and remove abandoned panelboards and distribution equipment.
 - G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Owner and Architect/Engineer with a Certificate of Destruction to verify proper disposal.
 - I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
 - J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.
 - K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.
 - L. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.
 - M. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - N. Floor slab on grade is a structural slab. All penetrations shall be X-rayed prior to cutting and/or drilling to avoid rebar or utilities encased in floor construction. Provide rebar dowels to replace damaged rebar and pin existing slab with patched slab. Refer to discipline plans for additional information.
 - O. Floor slab is post-tensioned. All penetrations shall be X-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.
 - P. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes X-ray or similar non-destructive means. Where conduit is in concrete slab, cut conduit flush with floor, pull out conductors, and plug conduit ends.
 - Q. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.4 EXISTING ENCLOSURES - NEW EQUIPMENT

- A. Existing enclosures may be reused to house new equipment including branch panels, industrial controls, and similar systems pending documented verification of the following provided with the applicable new equipment submittals.
 - 1. New equipment or panelboard is listed for the existing enclosure or application.
 - 2. Existing enclosure and new equipment is field evaluated by the manufacturer or nationally recognized testing laboratory for the available fault current, condition, and application.
 - 3. Authority Having Jurisdiction (AHJ) approval.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning as indicated on the drawings. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts. Replacement parts shall match specified components for new luminaires of same type when applicable. Reinstall luminaire and connect to circuiting as indicated on drawings.
- D. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

3.6 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

END OF SECTION 260505

SECTION 260513 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire
- B. Cabling for remote control, signal, and power limited circuits
- C. Fire rated and circuit integrity (CI) cable and assemblies
- D. Metal-clad cable (MC)

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. ASTM B800-05 - Standard Specification for 8000 Series Aluminum Alloy Wire Electrical Purposes-Annealed and Intermediate Tempered.
- B. ASTM B801-07 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
- C. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- D. NFPA 70 - National Electrical Code (NEC)
- E. CEC California Electrical Code
- F. UL 44 - Thermoset-Insulated Wires and Cables
- G. UL 83 - Thermoplastic-Insulated Wires and Cables
- H. UL 854 - Service-Entrance Cables
- I. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords
- J. UL 2196 - Fire Resistive, Fire Resistant and Circuit Integrity Cables
- K. California Division of State Architect (DSA) Interpretation of Regulations

1.4 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 260500.
- B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and Branch Circuits 8 AWG and larger: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.
- B. Feeders and Branch Circuits 8 AWG and larger in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.
- C. Feeders and Branch Circuits 10 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings.
- D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings.
- E. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- F. Aluminum conductors are not to be used for feeds to motor loads.
- G. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
 - 1. Fire alarm
 - 2. Low voltage switching and lighting control
 - 3. Electronic control
 - 4. Other specialized cabling, signal, and power limited cabling. Refer to the appropriate Division 23, 27, or 28 requirements; including, but not limited, to the following:
 - a. Building Automation Systems and Controls, Division 23.
 - b. Electronic Access Control, Intrusion Detection Systems, Video Surveillance, Division 28.
- B. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.
- C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- D. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 FIRE-RATED AND CIRCUIT INTEGRITY (CI) CABLE AND ASSEMBLIES

- A. Properties and requirements of fire rated cables and assemblies:
1. 2HR fire rated for horizontal and vertical installations.
- B. Acceptable fire-rated cables and listed assemblies:
1. Feeder assembly located outside the structure (example: below finished grade), rated metal stud and drywall enclosure, or encased in concrete; minimum 2 inches of concrete).
 2. Exothermal Mat Material: Raceway / Cable protected with exothermic mat material, UL listed.
 - a. Install per manufacturer guidelines and requirements. Apply appropriate quantity of wrapped layers of material as required to achieve rating.
 - b. Contractor shall upsize cable / wiring / raceway sizes as required for derating.
 - c. Provide cable / wire ampacity derating calculations for each application, reference manufacturer for additional information, document and submit derated calculations as a shop drawing submittal for approval prior to installation. Minimum cable / wire derating shall be:
 - 1) Individual conduit raceways (less than or equal to 4" trade size): 10%.
 - 2) Parallel conduit raceways associated with the same feeder and protected by a common installation assembly: 15%.
 - 3) Cable tray raceway: 50%.
 - d. Manufacturer:
 - 1) 3M Interam Endothermic Mat
 - 2) Or submitted for engineer review prior to bid.
 3. Mineral Insulated Cables: Copper conductor, 600-volt insulation, rated 90°C, Type MI.
 - a. Manufacturer:
 - 1) Raychem Pyrotenax MI
 4. MC Cable: Copper conductor, 600V thermoset, low smoke zero halogen silicone rubber insulation, continuously welded corrugated copper armor for equipment grounding conductor, rated 90°C, UL listed 2196. MC fire rated cable shall not be used for branch circuits that required redundant equipment ground paths per code.
 - a. Manufacturers:
 - 1) VITALink MC
 - 2) Draka Lifeline MC Series
 5. Fire rated cable in EMT or IMC raceway: Copper conductor, 300-volt or ethernet power-limited circuit cables low smoke zero halogen (LSZH), rated 105°C. Assembly including raceway shall be UL listed 2196 and UL circuit integrity (FHIT).

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- a. Manufacturers:
 - 1) VITALINK CI/CIC or ethernet series
 - 2) Draka RHW-2 EMT Series
 - 6. Fire rated cable in phenolic RTRC conduit: Copper conductor, 600-volt RHW-2 or RW90 low smoke zero halogen (LSZH) insulation, rated 90°C. Assembly shall be UL listed 2196 and UL circuit integrity (FHIT).
 - a. Manufacturer:
 - 1) Draka Lifeline RHW-2

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Above Accessible Ceilings:
 - 1. Building wire shall be installed in raceway.
 - 2. Metal clad cable, Type MC, 1/2" size with minimum #12 conductors and ground, shall be allowed for flexible whips to individual luminaires on non-essential circuits. The flexible whips shall be between 18" to 72" in length per Electrical Code.
- B. All Other Locations: Building wire in raceway.
- C. Above Grade: All conductors installed above grade shall be type "THHN".
- D. Underground or In Slab: All conductors shall be type "THWN".
- E. Low Voltage Cable (less than 100 volts): Low voltage cables in ducts, plenums, and other air handling spaces shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.
 - 1. J-hooks
 - 2. Bridle rings with saddle supports
- F. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.
- G. Fire-Rated 2-Hour Feeders and Circuit Requiring Continuous Operation (CI): Refer to Part 2 of this section for acceptable products and assemblies. Installation shall meet UL 2196.

3.2 CONTRACTOR CHANGES

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)). Service entrance conductors are based on copper conductor installed in underground electrical ducts, NEC Table B.2(7) (2011 - 2017 edition Table B310.15(B)(2)(7); 2008 or later edition B.301.7) or calculated in accordance with Annex B Application Information for Ampacity Calculation.

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- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
 - C. Underground electrical duct ampacity rating shall be in accordance with NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.
 - D. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.
 - E. Record drawing shall include the calculations and sketches.

3.3 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.
- D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
- E. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
- F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.
- G. Splice only in junction or outlet boxes.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Make conductor lengths for parallel circuits equal.
- J. All conductors shall be continuous in conduit from last outlet to their termination.
- K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
- L. Cables or wires shall not be laid out on the ground before pulling.
- M. Cables or wires shall not be dragged over earth or paving.
- N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.

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- P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.4 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Do not use wire pulling lubricant for isolated (ungrounded) power system wiring.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.
- H. Conductor Supports in Vertical Raceways:
1. Support conductors in vertical raceways in accordance with the Electrical Code Spacing of Conductors Supports.
 2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

3.5 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Use suitable cable fittings and connectors.
- C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.

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- D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.
 - E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.
 - F. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.
 - G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.6 FIRE-RATED CABLE AND ASSEMBLY INSTRUCTIONS

- A. Terminations of the fire-rated cable must be outside of the fire zone.
- B. Fire-rated cable shall be installed according to the manufacturer's instructions, recommendations, and UL listing.
- C. Route fire-rated cable and assemblies separate from other feeders and distribution. Install cable and assemblies in locations protected from physical damage.
- D. Refer to Electrical Identification Section 260553 for specific identification requirements.

3.7 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor. Cold shrink connector insulator with 1kV rating shall be used in damp and wet locations.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

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- H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
 - I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. Top to Bottom - A-B-C
 - J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.
 - K. Use antioxidant joint compound on all aluminum conductor terminations. Apply antioxidant joint compound per manufacturer's recommendations.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.
- C. MI cable shall have the insulation resistance of each cable tested with a 500-volt dc megohmmeter prior to energizing the cables. Tabulate resistance values and submit to Architect/Engineer for acceptance.
- D. Inspect wire and cable for physical damage and proper connection.
- E. Torque test conductor connections and terminations to manufacturer's recommended values.
- F. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- G. Provide documentation of the manufacturer's recommended lug torque value for copper and aluminum conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.
- H. Protection of wire and cable from foreign materials:
 - 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

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- I. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION 260513

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SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding system
- B. Bonding system
- C. Grounding electrode system
- D. Grounding of systems over 1kV

1.2 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with UL 467 Grounding and Bonding Equipment.
- E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- F. Comply with Electrical Code; for overhead-line construction and medium-voltage underground construction, comply with IEEE/ANSI C2 National Electrical Safety Code (NESC).

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)
- B. CEC California Electrical Code
- C. NFPA 99 - Standard for Healthcare Facilities

1.4 SUBMITTALS

- A. Submit shop drawings under provisions of Section 260500.
- B. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical electrodes.

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- C. Product Data: For each type of product indicated.
 - D. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - E. Indicate layout of ground field, location of system grounding electrode connections, and routing of grounding electrode conductor and ground ring.

1.5 SUMMARY

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section 260513 "Wire and Cable".
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated. Refer to Section 260553 for insulation color.
- D. Isolated Ground Conductors: Insulated. Refer to Section 260553 for insulation color.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- H. Aluminum Bonding Conductors: As follows:
 - 1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
 - 3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

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- I. GB; Grounding Bar:
 - 1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of technology or applicable room.
 - J. IBT; Intersystem Bonding Termination:
 - 1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.
 - 2. Manufacturers:
 - a. Harger GBI Series.
 - b. Erico EGB Series.

2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Hydraulic compression type or Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
- C. Bolted Connectors: Bolted-pressure-type connectors.

2.3 GROUNDING ELECTRODES

- A. Ground Rods Copper-clad steel.
- B. Ground Rods: Sectional type; copper-clad steel.
 - 1. Size: 3/4" in diameter by 120 inches per section.
- C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- D. Test Wells: Provide handholes as shown on drawings or as specified in Division 2 Section "Underground Ducts and Utility Structures."
- E. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to Electrical Code, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet of 1/2" steel reinforcing bar.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

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2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.
- G. Underground Connections: Exothermic-welded connections. Use for underground connections, except those at test wells.
- H. Connections at Test Wells: Use compression-type connectors on conductors and make two bolted- and clamped-type connections between conductors and ground rods.
- I. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity. The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.
- J. Tighten screws and bolts for grounding and bonding 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.
- K. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.
- 3.2 **INSTALLATION**
- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

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- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
 - C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.
 - D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
 - E. In raceways, use insulated equipment grounding conductors.
 - F. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
 - G. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by Electrical Code:
 - 1. Lighting and receptacle circuits. Terminate each end on a grounding lug or bus.
 - 2. Single-phase and three-phase motor and appliance branch circuits.
 - 3. Flexible raceway runs, including FMC and LFMC.
 - 4. Armored and metal-clad cable runs.
- D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- E. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- F. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

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- G. Isolated Grounding Circuits: Install an insulated equipment grounding conductor connected to the receptacle or equipment grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at isolated equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
 - H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.4 BONDING SYSTEM

- A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.
- B. Isolated Equipment Enclosure: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment bonding conductor.
- C. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.
- D. Equipment Circuits: Install a bonding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, dampers, and heaters. Bond conductor to each unit and to air duct. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps or copper conductor sized equal to the equipment grounding conductor.
- E. Bond metal ducts of dust collectors, particulate conveying, fume hoods, and other hazardous materials to the equipment grounding conductors of associated pumps, fans, or blowers. Use braided-type bonding straps. Provide braided bare copper bonding conductor in nonmetallic dust collector ductwork to each equipment inlet location, and bond to equipment.
- F. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.
- G. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.
- I. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.
- J. Industrial Control Panels, Terminal Cabinets, and Similar Installation: Terminate bonding conductor on cabinet grounding terminal. Provide an equipment grounding conductor and bond adjacent and associated control panels together.

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- K. Equipment Ground Conductor Continuity: All spliced equipment grounding conductors in junction boxes, cabinets, and distribution equipment shall be connected together and bonded to the metal enclosure.
 - L. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.
 - M. Metal Poles Supporting Outdoor Lighting Fixtures > 15 feet: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
 - N. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
 - O. Medical Gas Piping: Bond to pipe with grounding clamp connectors. Bonding conductor shall be a #6 AWG minimum and may be connected to panelboard ground bar serving the area.

3.5 GROUNDING ELECTRODE SYSTEM

- A. Ground Ring (Counterpoise):
 - 1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at average distances not more than 60 feet apart. Provide a grounding conductor, electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2 AWG for ground ring and for tap to building steel. Bury conductor not less than 30 inches below grade, 24 inches from building foundation, and 18 inches outside of roof drip line.
- B. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.
- C. Provide bonding at Utility Company's metering equipment and pad mounted transformer.
- D. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters, filtering devices, and similar equipment. Connect to pipe with grounding clamp connectors.

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- G. Natural Gas Service Piping: Bond to natural gas main service with grounding clamp connectors. Bonding conductor shall be connected to the main service ground bar. Provide grounding jumpers around all breaks in metallic continuity.
 - H. Natural Gas Equipment Piping: Bond each aboveground portion of natural gas metallic piping system at each equipment location with grounding clamp connectors. Bonding shall be performed after any flexible attachment nearest the equipment. The equipment grounding conductors may serve as the bonding means.
 - I. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
 - J. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 CONCRETE OR WOOD BUILDING GROUNDING SYSTEM

- A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived systems in accordance with Electrical Code. Individual grounding conductor taps from the separately derived systems to the common grounding electrode shall be sized in accordance with Electrical Code. All tap connections shall be made in an accessible location in such a manner that common grounding electrode conductor remains without a splice or joint.

3.7 EQUIPOTENTIAL (MULTI-POINT) GROUNDING SYSTEM

- A. Provide an equipotential grounding system in the following locations:
 - 1. Class I Div 1 and Div 2 locations as required in Electrical Code.
 - 2. Swimming pool, fountains, and similar locations as required in Electrical Code.
 - 3. Critical patient care and special care areas as indicated on drawings.
- B. The non-current-carrying metal parts of equipment, raceways and other enclosures shall be bonded to the grounding system.

3.8 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- B. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

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- C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 2 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation. The pad rebar shall be attached to the counterpoise conductor at the four corners.

3.9 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.
 2. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
 3. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
 4. Testing: Perform the following field quality-control testing:
 - a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 - c. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - 1) Equipment Rated 500 kVA and Less: 10 ohms.
 - 2) Equipment Rated 500 to 1000 kVA: 5 ohms.
 - 3) Equipment Rated More Than 1000 kVA: 3 ohms.
 - 4) Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - 5) Manhole Grounds: 10 ohms.
 - d. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

3.10 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION 260526

SECTION 260533 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Intermediate metallic conduit and fittings (IMC)
- B. Electrical metallic tubing and fittings (EMT)
- C. Flexible metallic conduit and fittings (FMC)
- D. Rigid polyvinyl chloride conduit and fittings (PVC)
- E. Wall and ceiling outlet boxes
- F. Electrical connection
- G. Pull and junction boxes
- H. Rough-ins
- I. Handholes
- J. Foundation - Underground Sleeves and Seals
- K. Raceway Seals and Sealant
- L. Accessories

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
 - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated
 - 5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
 - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
 - 2. A-A-55810 - Specification for Flexible Metal Conduit

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- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Underwriters Laboratories (UL): Applicable Listings
1. UL 1 - Flexible Metal Conduit
 2. UL 6 - Rigid Metal Conduit
 3. UL 360 - Liquid Tight Flexible Steel Conduit
 4. UL514-B - Conduit Tubing and Cable Fittings
 5. UL651-A - Type EB and a PVC Conduit and HDPE Conduit
 6. UL651-B - Continuous Length HDPE Conduit
 7. UL746A - Standard for Polymeric Materials - Short Term Property Evaluations
 8. UL797 - Electrical Metal Tubing
 9. UL1242 - Intermediate Metal Conduit
- G. American Standard of Testing and Materials (ASTM):
1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
 2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
 3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
 4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
 6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material
- H. Definitions:
1. Fittings: Conduit connection or coupling.
 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
 3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
 4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
 5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

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6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
 7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

1.4 SUBMITTALS

- A. Include fittings and conduits 1.5" and larger in coordination files. Include all in-floor and underfloor conduit in coordination files. Refer to Section 260500 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.
- B. Manufacturers:
 1. Atkore Allied Tube & Conduit
 2. Nucor
 3. Electroline
 4. Western Tube
 5. Wheatland Tube Co
 6. or approved equal.
- C. Fittings and Conduit Bodies:
 1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
 2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
 3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
 4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
 5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.
- D. Manufacturers of IMC Conduit Fittings:
 1. ABB/Thomas & Betts
 2. Easton/Crouse-Hinds
 3. Electroline
 4. Emerson Appleton & OZ Gedney
 5. Hubbell Raco and Killark
 6. NSI Bridgeport
 7. Orbit Industries
 8. Wesco Regal
 9. or approved equal.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Manufacturers of EMT Conduit:
 - 1. Allied Tube & Conduit
 - 2. Calbond Calpipe
 - 3. Nucor
 - 4. Electroline
 - 5. Western Tube
 - 6. Wheatland Tube Co
 - 7. or approved equal.
- C. Fittings and Conduit Bodies:
 - 1. 2" Diameter or Smaller: Compression or steel set screw type of steel designed for their specific application.
 - 2. 1/2" and 3/4" Conduit: Push-on connectors and couplers with locking ring and washer of zinc plated steel, listed for use in dry locations.
 - 3. Larger than 2": Compression or steel set screw type of steel designed for their specific application.
 - 4. Manufacturers of EMT Conduit Fittings:
 - a. ABB/Thomas & Betts
 - b. Eaton/Crouse-Hinds
 - c. Electroline
 - d. Emerson Appleton & OZ Gedney
 - e. Hubbell Raco and Killark
 - f. NSI Bridgeport
 - g. Orbit Industries
 - h. Wesco Regal
 - i. or approved equal.

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Manufacturers:
 - 1. ABB/Thomas & Betts
 - 2. Anamet Electrical
 - 3. Atkore American Flex AFC and Flexicon
 - 4. Electri-Flex Co
 - 5. Electroline
 - 6. Southwire Alflex
 - 7. or approved equal.
- C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
3. Manufacturers:
 - a. ABB/Thomas & Betts
 - b. Eaton/Crouse-Hinds
 - c. Electroline
 - d. Emerson Appleton & OZ Gedney
 - e. Hubbell Racor and Killark
 - f. NSI Bridgeport
 - g. Orbit Industries
 - h. Wesco Regal
 - i. or approved equal.

2.4 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers:
 1. ABB/Carlton
 2. Chevron Phillips Chemical Company
 3. Cantex, J.M. Mfg.
 4. Atkore Heritage Plastics
 5. or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.5 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: NEMA FB1, Type FD, Aluminum, cast ferrous alloy, or stainless steel deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

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- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
 - F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.
 - G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.6 ECONN; ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.7 JB; PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

2.8 ROUGH-IN

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,
- B. Conduit stubbed to above the lay-in ceiling.
- C. RI-TECH; Technology Rough-in:
 - 1. Rough-in shall have one (1) 1" conduit.

D. RI-TECH-C; Technology Rough-in - Ceiling Flush Mounted:

1. Mount flush in finished ceiling or as noted in plans. Rough-in shall have one (1) 1" conduit.

2.9 FOUNDATION - UNDERGROUND SLEEVES AND SEALS

A. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, raceways passing through foundation walls to an underground condition shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing element consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve.
3. Sleeves shall be at least 2 trade sizes larger than the penetrating raceway.
4. Pressure shall be maintained by stainless steel bolts and accessories. Pressure plates may be of composite materials for Models S and OS.
5. Sealing Elements shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
T	Fire Seals (1 hour)	Silicone	-67°F to 400°F
FS	Fire Seals (3 hours)	Silicone	-67°F to 400°F
OS	Oil Resistant / Stainless	Nitrile	-40°F to 210°F

6. Approved Manufacturers:
 - a. Thunderline Corporation "Link-Seals"
 - b. O-Z/Gedney Company
 - c. Calpico, Inc
 - d. Innerlynx
 - e. Polywater PGKD Series

2.10 RACEWAY SEALS AND SEALANT

A. Duct Sealant: Field applied expandable duct sealant, closed cell field cured, water tight, air tight. Identified for use with electrical cables, conductors, and raceways. Minimum liquid withstanding of 10-feet head of water (5 PSI). Compatible with conductors and raceways, UL94 Flammability Certified.

1. NOT ALLOWED. Duct seal putty, all-purpose construction sealant.
2. Manufacturers:
 - a. Polywater FST / AFT Series
 - b. Approved equal

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- B. Duct Seal Bushing: Custom mechanical seal, liquid tight, gas tight, stainless steel hardware. Minimum liquid withstanding of 10-feet head of water (5 PSI). Coordinate product with raceway size, cable quantities, and cable sizes.
1. Manufacturers:
 - a. Polywater PHRD / PHSD Series Varia /PHSI Module Series
 - b. Jackmoon Commscope DuctPlug Series
 - c. CalAm Manufacturing WedgeSeal Series
- C. Duct Seal Bushing Alternative Option: Inflatable duct seal system. Capable of withstanding a 10-foot head of water (5 PSI).
1. Manufacturers:
 - a. Raychem Rayflute Duct Sealing Systems RDSS
 - b. Approved equal
- D. Wall Sleeve Duct Seal System: Cast-in-place or Core-Drill two piece push-in- place construction, gasketed seal to prevent entry of water and gases.
1. Cable: Duct Seal Bushing, provide interior sleeve duct seal bushing for each duct entry. Provide duct seal bushings with individual seals for each applicable cable.
 2. Manufacturers:
 - a. Polywater Varia PHSI Series
 - b. Approved equal

2.11 ACCESSORIES

- A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control - IsoBacker Pad, SpecSeal - SSP Putty and Pads, 3M #MPP-4S or equal.
- B. Sound Barrier Insulation Pads: Mastic, non-hardening, sheet material, minimum 1/8" thickness applied to all five sides of back boxes. Kinetics Noise Control - SealTight Backer Pad, L.H. DOTTIE Co., #68 or equal.
- C. Electric Threaded Ball Swivel: Metallic body, box mounted, threaded conduit, 20-degree ball swivel, rated for weight of application, listed. Thomas and Betts, Appleton, Couse-hinds, or equal. Example applications:
1. Rigid pendant mount with sloped ceiling, vibration, or subject to wind.

PART 3 - EXECUTION

3.1 INSTALLATION TRAINING

- A. PVC coated rigid metal conduit, phenolic reinforced thermosetting resin conduit (phenolic RTRC), and reinforced thermosetting resin conduit (RTRC) manufacturers shall provide Contractor installation training for field cutting, joint preparation, joint assembly, field bending, and field cut sealing.

3.2 CONDUIT INSTALLATION SCHEDULE AND SIZING

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.
- B. Installation Schedule: Refer to drawings.
- C. Fire Rated Assemblies:
 - 1. Listed Fire Rated Assemblies: Phenolic RTRC
- D. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- E. Minimum Conduit Size (Unless Noted Otherwise):
 - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
 - 2. Below Grade 5' or less from Building Foundation: 1 inch.
 - 3. Below Grade More than 5' from Building Foundation: 1 inch.
 - 4. Telecommunication Conduit: 1 inch.
 - 5. Controls Conduit: 1/2 inch.
- F. Conduit Embedded in Slabs above Grade:
 - 1. Embedded installation NOT allowed in elevated slabs with metal composite decks nor structural pour in place slabs less than 6 inches in depth unless specifically noted or shown on drawings otherwise.
 - 2. Maximum size 1-1/4 inch for conduits crossing each other.
- G. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.3 CONDUIT ARRANGEMENT

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.

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- C. Conduit arrangement in elevated slabs (restricted to applications specifically noted or shown on drawings):
1. Conduit size shall not exceed one-third of the structural slab thickness. Place conduit between the top and bottom reinforcing with a minimum of 3" concrete cover.
 2. Parallel conduits shall be spaced at least 8 inches apart. Exception: Within 18 inches of commonly served floor boxes, junction boxes, or similar floor devices. Arrange conduits parallel or perpendicular to building lines and walls.
- D. Conduit shall not share the same cell as structural reinforcement in masonry walls.
- E. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.
- F. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- G. Contractor shall cooperate with all contractors on the project. Contractor shall obtain details of other contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by Contractor. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.
- 3.4 CONDUIT SUPPORT
- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

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- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
 - F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.
 - G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
 - H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
 - I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
 - J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
 - K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.
 - L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
 - M. Finish:
 - 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
 - 2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.5 CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
 - 2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.

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3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
 4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.
- C. Conduit Bends:
1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
 2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
 3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
 4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
 - a. A third bend is acceptable if:
 - 1) The total run is not longer than (33) feet.
 - 2) The conduit size is increased to the next trade size.
 5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
 6. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
 7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
 8. Use conduit bodies to make sharp changes in direction (i.e. around beams).
- D. Conduit Placement:
1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.
 2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
 3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
 4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.

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5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
 6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.
 7. **CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.**
 8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system.
 9. Horizontal conduit routing through slabs above grade
 - a. Conduits, if run in concrete structure, shall be in middle one-third of slab thickness, and leave at least 3" min. concrete cover. Conduits shall run parallel to each other and spaced at least 8" apart centerline to centerline. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Maximum conduit outside diameter 1".
 - b. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.
 - c. No conduits are allowed to be routed horizontally through slabs above grade.
 10. Do not route conduits across each other in slabs on grade.
 11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.
 12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.
 13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
 14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
 15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
 16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
 17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.6 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.

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- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
 - C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
 - D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
 - E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the Electrical Code, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.
 - F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
 - G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

3.7 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) OVERHEAD CONDUIT INSTALLATION

- A. Conduit shall be installed away from high temperature piping and equipment.
- B. Conduit shall be installed to prevent exposure to ultraviolet radiation.
- C. Proper allowances shall be made for expansion and/or contraction of the conduit during installation.
- D. Expansion fittings shall be installed in any 100' continuous run of conduit and at each 100' thereafter.
- E. Supports shall be made from non-corroding materials and spacing shall not be greater than the listing in the Electrical Code, but also shall not exceed the manufacturer's recommendations depending on the expected surface temperature.

3.8 UNDERGROUND CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.
- B. Conduit Bends (Lateral):
 - 1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.

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2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.
- C. Conduit Elbows (vertical):
1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (greater than 600V) and 18 inches for secondary conduits (less than 600V). Increase radius, as required, based on pulling tension calculation requirements.
- D. Expansion Fittings at Finished Grade: Provide underground raceways with an expansion fitting after emerging from finished grade and exterior equipment pads. Field locate the expansion fitting above and within 24 inches of finished grade. Raceways extending less than 12 inches above finished grade, transitioning to LFMC within 12 inches of finished grade, and interior concrete building slabs do not require an expansion fitting unless required by code.
- E. Conduit Placement:
1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.
 2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
 3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum $f'c = 2500$ and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
 4. Before the Contractor pulls any cables into the conduit, Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
 5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
 6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
 7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
 8. All non-metallic conduit installed underground outside of a slab shall be rigid.
- F. Horizontal Directional Drilling:
1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
 2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.
- G. Raceway Seal (Exterior to Raceway):
1. All power, telecommunication, electrical conduits and innerducts shall be sealed between the raceway and the building foundation. The raceway penetration shall be sealed liquid-tight, water-tight, non-corrosive.

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2. Below Grade Installation Options:
 - a. Cast-in-place concrete installation.
 - b. Hydraulic cement, hydraulic grout, hydraulic epoxy.
 - c. Foundation - Underground Sleeves and Seals; refer to Part 2-Products for product information.
 3. Above Grade Installation Options:
 - a. Masonry grout for masonry applications.
 - b. Caulk Sealant, interior/exterior rated, color per architect. Refer to architectural specifications for additional requirements.

H. Raceway Seal (Interior to Raceway, with Cables or Empty):

1. All power, telecommunication, electrical conduits and innerducts, including those with cables, shall be sealed at the building and vault entry. The seal shall prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceways shall also be sealed.
2. Installation Schedule, nominal size:
 - a. 2" or less: Duct Seal Bushing or Duct Sealant
 - b. 2-1/2" through 4": Duct Seal Bushing
 - c. 5" and 6": Wall Sleeve Duct Seal System

3.9 BOX INSTALLATION SCHEDULE

A. Galvanized steel boxes may be used in:

1. Concealed interior locations above ceilings and in hollow studed partitions.
2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
3. Direct contact with concrete except slab on grade.
4. Recessed in stud wall of kitchens and laundries.

B. Cast boxes shall be used in:

1. Exterior locations.
2. Hazardous locations.
3. Exposed interior locations within 8' of the highest platform level.
4. Direct contact with earth.
5. Direct contact with concrete in slab on grade.
6. Wet locations.
7. Kitchens and laundries when exposed on wall surface.

3.10 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

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- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
 - D. Locate and install to maintain headroom and to present a neat appearance.
 - E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.11 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls.
 - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
 - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.
- C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
- D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
- E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- F. Provide knockout closures for unused openings.
- G. Support boxes independently of conduit.
- H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- I. Install boxes in walls without damaging wall insulation.
- J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
- K. Position outlets to locate luminaires as shown on reflected ceiling drawings.

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- L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
 - M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
 - N. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.12 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Do not install boxes back-to-back in walls.
 - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
 - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.13 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.

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- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
 - F. Wood, plastic, or fiber plugs shall not be used for fastenings.
 - G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION 260533

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SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhesive Markings and Field Labels
- B. Nameplates and Signs
- C. Product Colors

1.2 REFERENCES

- A. NFPA 70E - National Electrical Safety Code
- B. NFPA 70 - National Electrical Code (NEC)
- C. ANSI A13.1 - Standard for Pipe Identification
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

1.3 QUALITY ASSURANCE

- A. Electrical identification products shall be suitable for the environment installed. Identification labels damaged by the environment due to ultraviolet light fading, damp or wet conditions, physical damage, corrosion, or other conditions shall be replaced with labels suitable for the environment.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 Specification Sections and under provisions of Section 260500.
 - 1. Product Data for each type of product specified.
 - 2. Schedule of nomenclature to be used for identification signs and labels for each piece of equipment including, but not limited to, the following equipment types as specified in Division 26.
 - 3. Samples of each color, lettering style and other graphic representation required for identification materials including samples of labels and signs.
 - 4. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 21/22/23.

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

- A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).
 - 1. Label Size as follows:
 - a. Raceways: Kroy or Brother labels 1-inch high by 12-inches long (minimum).
 - 2. Color: As specified for various systems.
- B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- C. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from -40°F to 185°F (-40°C to 85°C), type 2/2S or type 21/21S based on application. Provide ties in specified colors when used for color coding. Cable ties shall be listed and identified for the application, securement, and support.
- F. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.
- G. Aluminum, Wraparound Marker Bands: 1-inch width, 0.014 (5mm) inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- H. Brass or Aluminum Tags: 2" (50mm) by 2" (50mm) by .05-inch metal tags with stamped legend, punched for fastener.
- I. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.
- J. Text Sizes:
 - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
 - a. Font: Normal 721 Swiss Bold
 - b. Adhesive Labels: 3/16 inch minimum text height
 - c. Vinyl / Plastic Laminate Labels: 3/4" inch minimum text height

2.2 NAMEPLATES AND SIGNS

- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.
- B. Text Sizes:
 - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
 - a. Text Height: 3/8 inch minimum
- C. Baked-Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- E. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- F. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

2.3 PRODUCT COLORS

- A. Adhesive Markings and Field Labels:
 - 1. Normal Power and General Labels: Black letters on white face
 - 2. Fire Alarm: Red letters on white face
- B. Nameplates and Signs:
 - 1. NORMAL POWER: Black letters on white face
 - 2. GROUNDING: White letters on green face.
 - 3. CAUTION or UPS: Black letters on yellow face
- C. Raceways and Conduit:
 - 1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:
 - a. Normal Power and General Distribution: Silver
 - b. Fire Alarm System: Red
 - c. Temperature Controls: Refer to mechanical cover sheet for color
 - d. Ground: Green
 - e. Low Voltage and Telephone: Purple
 - f. Clock, Sound, Security System, and Intercom: Black
- D. Box Covers:
 - 1. Box cover colors shall match conduit colors listed above.

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- E. Conductor Color Identification: Refer to Part 3 for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. Exposed Ceilings and Finished Spaces: The project includes exposed ceilings in finished spaces. The installation of colored raceways and labeling may not be aesthetically desirable in finished spaces. The contractor shall coordinate identification requirements in exposed ceilings of finished spaces with the Architect/Engineer prior to installation and ordering of materials.
- C. Electrical System Color Chart: This Contractor shall furnish and install framed 8" x 12" charts of the color-coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.
- D. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.
- E. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- F. Circuit Identification: Tag or label conductors as follows:
1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- G. Apply Danger, Warning, Caution and instruction signs as follows:
1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.
 3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
 4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.

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5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- H. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- I. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- J. Install ARC FLASH WARNING signs on all power distribution equipment per Section 260573.
- K. Install ARC FLASH WARNING signs on all switchboards, switchgear, distribution panels, branch panelboards, industrial control panels, and motor control centers.
1. Sample Label:
- ! WARNING
ARC FLASH AND SHOCK HAZARD
APPROPRIATE PPE REQUIRED
FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY
REFER TO NFPA 70E
- L. Circuits with more than 600V: Identify raceway and cable with "DANGER-HIGH VOLTAGE" in black letters 2 (50mm) inches high on orange background at 10'-0 foot intervals.
1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.
- M. Selective Coordination Label: Install caution signs on all switchboards, distribution panels, panelboards, disconnects, and other equipment with selectively coordinated overcurrent protection devices. Sign at a minimum shall contain:
1. CAUTION: OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED. EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED.
- N. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded. Limit line markers to direct-buried cables.

3.2 FEEDER AND BRANCH CIRCUIT DIRECTORIES

- A. Product:
 - 1. Adhesive labels and field markings
 - 2. Nameplates and signs
- B. Feeder Directories Branch: Provide each feeder, branch circuit, feeder modification, and branch circuit modification with a typed circuit directory label. Refer to technical equipment specification sections for additional requirements. Include the following with each label:
 - 1. Load Description: Lighting, receptacles, specific equipment, spare, space, or similar description.
 - 2. Location: Room name, number, location.
- C. Provide a factory or custom clear plastic sleeve for each branch panel directory and secure to inside panel cover.

3.3 LIGHTING CONTROL AND RECEPTACLE COVER PLATES

- A. Product:
 - 1. Adhesive labels and field markings
 - 2. Nameplates and signs
- B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.
- C. Identification material to be engraved plastic-laminated labels, 1/16-inch minimum thickness with white letters on a red face. Letter and number size to 1/8-inch high.
- D. Identification to be engraved directly on the stainless steel coverplates. Letter and number size to 1/8-inch high.
- E. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (e.g. "C1A #24"). Identification for switch cover plates shall be installed on the inside cover.

3.4 BOX LABELING

- A. Products:
 - 1. Adhesive labels and field markings
- B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape OR Brother self-laminating vinyl label, letters/numbers color coded same as conduits. In rooms that are painted out, provide labeling on inside of cover.
- C. All junction, pull, and connection boxes shall be identified as follows:
 - 1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").
 - 2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").

3.5 CONDUCTOR COLOR CODING

A. Products:

1. All wire and cables shall be color coded by the manufacturer.

B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

C. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

D. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.

E. Conductors shall be color coded as follows:

1. 120/240 Volt, 3-Wire:

- a. A-Phase - Black
- b. B-Phase - Red
- c. Neutral - White
- d. Ground Bond - Green

2. 208Y/120 Volt, 4-Wire:

- a. A-Phase - Black
- b. B-Phase - Red
- c. C-Phase - Blue
- d. Neutral - White
- e. Ground Bond - Green

3. 480Y/277 Volt, 4-Wire:

- a. A-Phase - Brown
- b. B-Phase - Orange
- c. C-Phase - Yellow
- d. Neutral - Gray
- e. Ground Bond - Green

4. Grounding Conductors:

- a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.
- b. Isolated Equipment Ground Conductors: Green with colored distinctive yellow stripe along the entire length of the conductor. Isolated ground for feeders, use colored tape with alternating bands of green and yellow to provide a minimum of three bands of green and two bands of yellow.

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5. Cabling for Remote Control, Signal, and Power Limited Circuits:
- a. Fire Alarm: Refer to Fire Alarm and Automatic Detection Section 283100 for cable color requirements.
 - b. Low Voltage Switching: Per manufacturer recommendations and code requirements.
 - c. Building Automation Systems and Control: Refer to the Temperature Control Contactor notes located on the mechanical cover sheet.
 - d. Nurse Call: Refer to Division 27.
 - e. Electronic Control: Per manufacturer recommendations and code requirements.
 - f. Audio/Visual Systems: Refer to Division 27.
 - g. Structured Cabling: Refer to Division 27.

3.6 CONTROL EQUIPMENT IDENTIFICATION

- A. Products:
- 1. Nameplates and signs
- B. Provide identification on the front of all control equipment such as combination starters, starters, VFDs, contactors, motor control centers, etc.
- C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner.
- D. Labeling shall include:
- 1. Equipment type and contract documents designation of equipment being served.
 - 2. Location of equipment being served if it is not located within sight.
 - 3. Voltage and phase of circuit(s).
 - 4. Panel and circuit number(s) serving the equipment.
 - 5. Method of automatic control, if included ("AUTO CONTROL BY FMCS").
 - 6. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
 - 7. Date of fault current study, refer to one-line diagram
 - 8. Sample Label:

EXHAUST FAN EF-1 ("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"
AUTO CONTROL BY FMCS
22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

3.7 EQUIPMENT CONNECTION IDENTIFICATION

- A. Products:
- 1. Nameplates and signs
- B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.

-
- C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner. The following list of equipment is specifically being listed to receive an equipment connection label; this list does not limit the equipment that shall receive a label:
1. Mechanical heating, ventilation, and air conditioning equipment; chillers, boilers, pumps, air handling ventilation units, condensing units, unit heaters, and similar equipment
 2. Plumbing equipment
 3. Fire protection equipment including fire pumps
 4. Elevator

D. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served
2. Location of equipment being served if it is not located within sight.
3. Voltage and rating of the equipment.
4. Panel and circuit numbers(s) serving the equipment
5. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
6. Date of fault current study; refer to one-line diagram
7. Sample Label:

UNIT HEATER UH-1 ("LOCATED IN STORAGE ROOM 200")
480V: 3-PHASE
FED FROM "1HA1-1"
22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

3.8 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards, switchgear, motor control centers, generators, UPS, storage battery disconnects, transfer switches, etc. Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and identify each cubicle of multi-section gear.

1. Interior Equipment: The identification material shall be engraved plastic-laminated labels.
2. Exterior Equipment: The identification material shall be engraved vinyl labels.
3. Labeling shall include:
 - a. Essential Electrical System EES: When applicable the label shall include "Essential Electrical System EES". Applicable equipment includes components of the life safety and critical branch for healthcare facilities (generators, transfer switches, switchboards, distribution panels, panelboards, etc.).
 - b. Equipment type and contract documents designation of equipment.
 - c. Voltage of the equipment.
 - d. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
 - e. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").

-
- f. Sample Label:
- DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELEC ROOM)
4. Provide the following on a separate label, installed below the label above:
- a. Available fault current; refer to one-line diagram or panel schedules
b. Date of fault current study; refer to one-line diagram
c. Sample Label:
- 22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017
- C. Service Equipment Label: A separate nameplate for the service entrance equipment and include:
1. Nominal system voltage, service wire size, quantity, material, distance
2. Maximum available fault current; refer to one-line diagram for values
3. Clearing time of overcurrent protection devices based on available fault current. Refer to calculations and report from Section 260573 for value.
4. Date of fault current study; refer to one-line diagram
5. Date of label
6. Sample Label:
- 480Y/277V, 6 SETS 4#750KCM CU, 75FT
39,800 AMPS AVAILABLE FAULT CURRENT
0.07 SECOND CLEARING TIME
DATE OF STUDY: 1 JAN 2017
DATE OF LABEL: 4 JUL 2017
- D. Arc Energy Reduction Label:
1. Provide a separate engraved plastic laminate label centered at the top of each vertical section of the electrical gear indicating the following when applicable.
- a. Label: "This equipment is designed with a system listed below".
b. Applicable Systems:
- 1) Arc energy reducing maintenance switch
- E. Adjustable-Trip Over Current Protection Label:
1. Provide a separate engraved plastic laminate label adjacent to each overcurrent projection device with adjustable trip settings. Provide label separate from load identification label.
- a. Label:
- 1) Long-time delay:
2) Long-time pickup:
3) Short-time delay:
4) Short-time pickup:

-
- 5) Instantaneous:
 - 6) Ground fault delay:
 - 7) Ground fault:

b. Sample Label:

Long-time delay:	10.0
Long-time pickup:	1.0
Short-time delay:	0.15
Short-time pickup:	5.0
Instantaneous:	2.0
Ground fault delay:	0.25
Ground fault:	50.0

F. Nominal System Voltage Label:

- 1. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used in the panelboard or equipment shall be permanently posted on the interior of the door or cover.

G. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1"). Provide a separate engraved plastic laminate label adjacent to each overcurrent protection device with feeder wire size, feeder wire quantity, conductor material and distance in feet. Provide label separate from load identification label and adjustable trip settings label.

1. Sample Labels for Feeders:

4#3/0 CU & 1#6 CU GND, 125FT
4#250KCM AL & 1#6 GND CU, 125FT
2 SETS 4#400KCM CU & 1#1 GND CU, 125FT

H. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 260500 for other requirements.

3.9 INDUSTRIAL CONTROL PANEL IDENTIFICATION

A. Products:

- 1. Nameplates and signs

B. Provide identification on the front of all industrial control panels and similar equipment. Labels shall be visible on the exterior of the gear and correspond to the one-line and/or schematic diagram nomenclature.

- 1. Interior equipment: The identification material shall be engraved plastic-laminated labels.
- 2. Labeling shall include:
 - a. Equipment type and contract documents designation of equipment.
 - b. Manufacturer / Assembler of industrial control panel
 - c. Voltage, phase, frequency, full load current of each supply circuit

-
- d. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
 - e. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").
 - f. Sample Label:

INDUSTRIAL CONTROL PANEL ICP-1
ABC COMPANY
480V, 3PHASE, 60HZ, 60A (PANEL E1-1 LOCATED IN ELEC 123)
120V, 1PHASE, 60HZ, 20A (PANEL E2-1 LOCATED IN ELEC 123)
22,000 SHORT CIRCUIT RATING

C. Nominal System Voltage Label:

- 1. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used shall be permanently posted on the interior of the door or cover of the industrial control panel.

D. Schematic Diagram: Provide a laminated copy of the industrial control panel schematic wiring diagram. Post the diagram on the inside cover of the control panel.

E. Service Equipment Label: Refer to Electrical Distribution Equipment - Service Equipment Label of this specification if applicable for additional requirements.

3.10 TRANSFORMER EQUIPMENT IDENTIFICATION

A. Products:

- 1. Nameplates and signs

B. Provide identification on the front of all transformers. The identification nameplate shall be an engraved plastic-laminated label.

C. Labeling shall include:

- 1. Equipment type and contract documents designation of equipment
- 2. Name of the upstream equipment.
- 3. Voltage and rating of the equipment.
- 4. Location of the upstream equipment if it is not located within sight.
- 5. Sample Label:

TRANSFORMER TR-15
480V: 208Y/120V 15KVA
FED FROM SWITCHBOARD "SB-1" (LOCATED IN ELEC 123)

3.11 DC VOLTAGE EQUIPMENT IDENTIFICATION

A. Products:

- 1. Names and signs

B. Provide identification on the front of all DC voltage equipment, storage batteries, disconnects. The identification nameplate shall be engraved plastic-laminate label.

C. Label shall include:

1. Equipment type and contract documents designation of equipment.
2. Name of upstream equipment and location of the upstream equipment if it is not located within sight.
3. Nominal equipment voltage and rating.
4. Available fault current (from batteries if applicable).
5. Date of fault current study; refer to one-line diagram.
6. Sample Label:

STORAGE BATTERY SB-1
600 VOLT DC, 50 KVA
39,800 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

3.12 ELECTRICAL WORKING CLEARANCE IDENTIFICATION

A. Products:

1. Safety Yellow paint and custom stencils

B. Provide custom identification of electrical equipment working clearances in mechanical, electrical, storage, janitorial, and similar non-public areas.

C. Identification shall include a painted rectangular box (on the finished floor) in front of the electrical equipment to define the code-required working clearance. Provide additional diagonal stripping inside the rectangle box. All painted stripping shall be safety yellow paint with 3 inch wide stripes.

1. Width of area: Width of equipment or as required by code
2. Depth of area: Depth as required by code

3.13 SERIES RATING IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Upstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate reading "CAUTION - SERIES RATED SYSTEM - IDENTICAL COMPONENT REPLACEMENT REQUIRED".

C. Downstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate reading "CAUTION - SERIES RATED SYSTEM - ADDITIONAL SERIES COMBINATION RATING: XX,XXX RMS SYMMETRICAL AMPERES" where XX,XXX shall be the series combination rating.

3.14 DWELLING UNIT IDENTIFICATION

A. Products:

1. Nameplates and signs

-
- B. Emergency Disconnect (exterior), provide EMERGENCY DISCONNECT label on exterior emergency disconnect, red background, white letters, 1/2" high letters, or as required by code. The identification nameplate shall be engraved plastic-laminate label.

3.15 POLE IDENTIFICATION

- A. Product:
 - 1. Adhesive labels and field markings
 - 2. Nameplates and signs
- B. Lighting poles, bollards and overhead distribution poles shall be individually identified with a unique number, for maintenance purposes. Apply the vinyl label number above the hand hole cover or 24" (610mm) above grade. Bollards may be identified with a number applied inside the luminaire that is visible from the exterior.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Device plates and box covers
- B. Receptacles (REC-#)

1.2 QUALITY ASSURANCE

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Electrical Code, by a testing agency to Authorities Having Jurisdiction and marked for intended use.
- C. Comply with the Electrical Code.

1.3 REFERENCES

- A. DSCC W-C-896F - General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. NEMA WD 1 - General Color Requirements for Wiring Devices
- D. NEMA WD 6 - Wiring Devices - Dimensional Requirements
- E. NFPA 70 - National Electrical Code (NEC)
- F. UL 498 - Standard for Attachment Plugs and Receptacles
- G. UL 943 - Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.
- C. Provide a non-returnable sample of each countertop and furniture-mounted receptacle assembly as part of the submittal process.

1.5 COORDINATION

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

- A. All switch, receptacle, and outlet colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

- A. All switches, receptacles, and outlets shall be complete with the following:
1. Unbreakable thermoplastic/thermoset plastic and match device color coverplates in finished spaces where walls are finished.
 2. Decorator Grade - Public: Decorator thermoplastic and match device color wallplates in public finished spaces where walls are finished.
 - a. Manufacturer:
 - 1) Leviton Decora
 - 2) Hubbell Decorator
 - 3) Cooper Decorator
 - 4) or approved equal
 3. Decorator Grade - Screwless: Decorator snap-on nylon or polycarbonate wallplates with sub-base in public finished spaces; match device color.
 - a. Manufacturer:
 - 1) Leviton 803##
 - 2) Hubbell RCW
 - 3) Cooper PJS
 - 4) Pass & Seymour SWP
 - 5) or approved equal
 4. #302 stainless steel coverplates in unfinished spaces for flush boxes.
 5. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.
 - B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
 - C. Install nameplate identification as indicated in Section 260553.
 - D. Plate securing screws shall be metal with head color matching the wall plate finish.
 - E. Where indicated on drawings, provide compatible wire guards for devices to protect against damage and vandalism. Wire guards shall be constructed of durable coated steel wire.

2.3 RECEPTACLES

- A. Refer to Electrical Symbols List for device type.
- B. Devices that are shaded on the drawings shall be red.

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- C. Devices that are shaded on the drawings shall be red and shall have an illuminated face or indicator light to indicate that there is power to the device.
- D. REC-DUP: NEMA 5-20R Duplex Receptacle:
1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.
 - a. Manufacturers:
 - 1) Hubbell 5352A
 - 2) Leviton, 5362-S
 - 3) Pass & Seymour 5362
 - 4) Cooper 5352
 2. Decorator Grade: Provide decorative style duplex receptacles in public spaces where walls are finished.
 - a. Manufacturers:
 - 1) Hubbell DR20
 - 2) Leviton 16362
 - 3) Pass & Seymour 26342
 - 4) Cooper 6352
 3. Spec Grade: 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and brass back strap.
 - a. Manufacturers:
 - 1) Hubbell 5352
 - 2) Leviton 5362-S
 - 3) Pass & Seymour 5362
 - 4) Cooper 5362
 4. Heavy Duty: 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.
 - a. Manufacturers:
 - 1) Hubbell 5362
 - 2) Leviton 5362
 - 3) Pass & Seymour 5362A
 - 4) Cooper AH5362
- E. REC-DUP-GFI: NEMA 5-20R Ground Fault Duplex Receptacle:
1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, listed.
 - a. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

-
- b. Manufacturers:
- 1) Hubbell GF20L
 - 2) Leviton GFNT2
 - 3) Pass & Seymour 2097
 - 4) Cooper SGF20
- F. REC-DUP-W: NEMA 5-20R Weatherproof While-In-Use Ground Fault Duplex Receptacle:
1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, weather resistant WR listed. Provide extra-duty NEMA 3R rated while-in-use cast aluminum outlet box hood.
 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
- a. Manufacturers:
- 1) Hubbell:
 - a) GFTWRST20 with aluminum housing WP826
 - b) GFCI type devices are not allowed. Contractor may substitute an alternative manufacturer when Hubbell is the basis of submittal for all other wiring devices.
 - 2) Leviton GFWT2 with aluminum housing M5979
 - 3) Pass & Seymour 2097TRWR with aluminum housing WIUCAST1
 - 4) Cooper WRSGF20 with aluminum housing WIUMV-1
- G. REC-DUP-WP: NEMA 5-20R Weatherproof While-NOT-In-Use Ground Fault Duplex Receptacle with gasketed NEMA 4X cover:
1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, weather resistant WR listed. Provide extra-duty NEMA 4X rated while-not-in-use metallic outlet box hood.
 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
- a. Manufacturers:
- 1) Hubbell:
 - a) GFTWRST20 with gasketed NEMA 4X while-NOT-in-use metallic cover.
 - b) GFCI type devices are not allowed. Contractor may substitute an alternative manufacturer when Hubbell is the basis of submittal for all other wiring devices.
 - 2) Leviton GFWT2 with gasketed NEMA 4X while-NOT-in-use metallic cover.
 - 3) Pass & Seymour with gasketed NEMA 4X while-NOT-in-use metallic cover.
 - 4) Cooper WRSGF20 with gasketed NEMA 4X while-NOT-in-use metallic cover.

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- H. REC-QUAD: NEMA 5-20R Double Duplex Receptacle:
1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
 - a. Manufacturers:
 - 1) Refer to Duplex Receptacle above.
- I. REC-QUAD-GFI: NEMA 5-20R Double Duplex GFI Receptacle:
1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.
 - a. Manufacturers:
 - 1) Refer to Duplex GFI Receptacle above.
- J. REC-QUAD-WP: NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:
1. Consists of two duplex, GFCI receptacles. Double gang box. Provide extra-duty NEMA 3R rated while-in-use cast aluminum outlet box hood.
 - a. Manufacturers:
 - 1) Receptacle: Refer to GFCI Receptacle above.
 - 2) Cover:
 - a) Intermatic WP1030MXD
 - b) Pass & Seymour WIUCAST2
 - c) Thomas & Betts Red Dot 2CKU
- K. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.
- L. Side wired devices shall have four binding screws that are undercut for positive wire retention.
- M. Ground fault circuit interrupter (GFCI) receptacles shall be listed and comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.
- N. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.
- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

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- C. Ground Fault Protection: Provide ground fault protection for all branch circuit breakers serving 120/208 receptacles and electrical outlets rated 50 amps or less single-phase and 100 amps or less three-phase in the following locations, as shown on drawings, or required by adopted code:
1. Rooftops
 2. Interior/Exterior locations subject to damp/wet conditions
 3. Garages, accessory buildings, service bays
 4. Exterior dwelling outlets (disconnects, equipment connections, etc.) when required by code.
 5. Specific Appliances: Auto vacuum machines, water drink/bottle fill coolers, pressure staying machines, tire inflation machines, vending machines, sump pumps, dishwashers, electric ranges, ovens, clothes dryers, microwave ovens
 6. Future Provisions: Provide a conduit raceway and backbox for the future addition of countertop pop-receptacle when receptacles are not installed in kitchen islands and peninsulas.
- D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.
- H. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 260553 - Electrical Identification.
- I. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION 262726

SECTION 262816 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Non-fusible switches
- C. Molded case circuit switches
- D. Molded case switches
- E. Motor disconnect switch
- F. Mechanically interlocked disconnect
- G. Enclosures

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Product Data: For each type of enclosed switch, circuit breakers, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

A. Acceptable Manufacturers:

1. Square D 3110 Series
2. Eaton DH Series
3. ABB TH Series
4. Siemens HNF / HF Series

B. FDS-#; Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

C. DS-#; Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.

D. Enclosures: Type as indicated on the disconnect schedule.

E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.

1. Lockable
2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

A. Acceptable Manufacturers:

1. Square D
2. Eaton
3. ABB
4. Siemens

B. CB-#; Molded Case Circuit Breaker: NEMA AB 1, 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 settings.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t responses.

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- 4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 - C. CB-#; Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
 - D. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

2.3 MOTOR DISCONNECT SWITCH

- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series
 - 2. Eaton r5 Series
 - 3. ABB ML Series
 - 4. Siemens LBR Series
- B. MD-#; Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.
- C. Enclosures: Type as indicated on the Disconnect Schedule.
- D. Ground lug connection provided in enclosure.
- E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.
- F. Listed UL 508 suitable for motor control.

2.4 MECHANICALLY INTERLOCKED DISCONNECT

- A. Acceptable Manufacturers:
 - 1. Disconnect
 - a. Square D 3110 Series
 - b. Eaton DH Series
 - c. ABB TH Series
 - d. Siemens HF Series

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- 2. Receptacle
 - a. Crouse-Hinds Arktite
 - b. Appleton Powertite

 - B. DSS-#; Switch and Plug Assemblies: Rated for making and breaking loads, enclosed switch with externally operable interlock to prevent disconnecting receptacle with switch in ON position or inserting receptacle in ON position without a tool. Padlock lockable provision to meet OSHA lockout/tagout regulations.

 - C. Enclosures: Type as indicated on the Disconnect Schedule.

 - D. Ground lug connection provided in enclosure.

 - E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Matching male pin and sleeve plug, two auxiliary/pilot contacts.
 - 3. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

 - F. Listed UL 2682 suitable for motor disconnect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on the drawings.

- B. Install fuses in fusible disconnect switches.

- C. Field coordinate installation with other contractors and equipment to maintain code required working space requirements.

- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ADJUSTING

- A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION 262816

SECTION 264100 - LIGHTNING PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Air terminals and interconnecting conductors
- B. Grounding and bonding for lightning protection

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 260526 - Grounding and Bonding
- B. Section 264300 - Surge Protection Devices

1.3 REFERENCES

- A. ANSI/NFPA 780 - Lightning Protection Code
- B. ANSI/UL 96 - Lightning Protection Components
- C. LPI-175 - Lightning Protection Institute Installation Standard
- D. LPI-176 - Lightning Protection Institute System Material and Components Standards
- E. UL 96A - Installation Requirements for Lightning Protection Systems

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260500.
- B. Shop drawings shall indicate layout of air terminals, grounding electrodes, and bonding connections to structure, ground grid, and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details. Include indications for use of raceway and type, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.
- C. Product data shall show dimensions and materials of each component, and include indication of listing in accordance with ANSI/UL 96 or a nationally recognized testing laboratory.
- D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.
- E. Submit manufacturer's installation instructions under provisions of Section 260500.
- F. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.
- G. Field inspection reports indicating compliance with specified requirements.

1.5 SYSTEM DESCRIPTION

- A. Lightning Protection System: System protecting building, consisting of air terminals on roofs, roof-mounted mechanical equipment, and penthouse roofs; bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors. Class I materials shall be used for systems on structures not exceeding 75 feet in height. Class II materials shall be used for systems on structures exceeding 75 feet in height above grade.
- B. Performance Statement: This specification and the accompanying roof plans describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every air terminal, conductor, and connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all equipment and wiring required for a complete and operational system.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit project record documents under provisions of Section 260500.
- B. Accurately record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors.
- C. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in lightning protection equipment with minimum three (3) years documented experience and a member of the Lightning Protection Institute or who is listed by a nationally recognized testing laboratory.
- B. Installer: Authorized installer of manufacturer with minimum three (3) years documented experience and certified by the Lightning Protection Institute.
- C. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene a pre-installation conference one week prior to commencing work of this Section.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate work under provisions of Section 260500.
- B. Coordinate the work of this Section with exterior and interior finish installations. Coordinate painting of exposed conduits to match building finish with Architect.
- C. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.
- D. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Heary Brothers Lightning Protection Co., Inc
- B. Thompson Lightning Protection
- C. Harger Lightning Protection
- D. Robbins Lightning, Inc
- E. Erico International Corporation
- F. Burndy Thermoweld
- G. VFC Lightning Protection

2.2 MATERIALS

- A. All materials shall be copper and/or copper-bronze. In locations where the system components are mounted on aluminum surfaces, aluminum materials shall be used to avoid electrolytic corrosion of dissimilar metals.
- B. Components: In accordance with ANSI/UL 96 or nationally recognized testing laboratory.
- C. Air Terminals: Solid, unless otherwise indicated. Provide air terminals with safety 3/4" sphere tip. Provide swivel adapters to plumb air terminals when mounting on sloping surfaces.
- D. Air Terminal for Chimney: Lead-coated copper.
- E. Grounding Rods: Copper clad steel.
- F. Ground Plate: 18"x18"x0.032" Copper ground plate.
- G. Connectors and Splicers: Bronze, unless otherwise indicated.
- H. Early Stream Emitter (ESE) Air Terminal: Enhanced air terminal.
- I. ESE Mast: Aluminum or stainless steel mast with base and supports designed for 100 mph wind and 1.3 gust factor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify that field measurements are as shown on the shop drawings.
- C. Beginning of installation means installer accepts existing conditions.

3.2 PROTECTION OF SURROUNDING ELEMENTS

- A. Protect elements surrounding work of this Section from damage or disfiguration.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with ANSI/NFPA 780, UL 96A, and LPI-175.
- C. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops.
- D. Conceal the following conductors:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view from exterior locations at grade within 200 feet of building.
 - 5. Notify Architect/Engineer at least 48 hours in advance of inspection before concealing lightning protection components.
- E. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
- F. Bond extremities of metal bodies exceeding 60 feet in vertical length to structural steel members.
- G. Provide a ground ring electrode that meets or exceeds minimum requirements in NFPA 780.
 - 1. Bond ground terminals to ground ring electrode.
 - 2. Bond grounded metal bodies on building within 12 feet of ground to ground ring electrode.
 - 3. Bond grounded metal bodies on building within 12 feet of roof to interconnecting loop at eave level or above.
- H. Structures exceeding 60 feet in height: Bond lightning protection components with intermediate-level interconnection loop conductors to down conductors and other grounded media at maximum 60-foot intervals.

3.4 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.
- C. Bi-metal transition fittings shall be used when changing between aluminum and copper conductors.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260500.
- B. Obtain the services of Underwriters' Laboratories, Inc. to provide inspection and certification of the lightning protection system under provisions of UL 96A to obtain a UL Master Label for system.
- C. Install UL Master Label and attach to building at location directed by the Owner.
- D. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.

END OF SECTION 264100

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SECTION 265119 - LED LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Exterior luminaires and accessories
- C. Light-emitting diode (LED) luminaire systems
- D. LED emergency lighting units
- E. Emergency exit signs
- F. Emergency inverter for LED light engines (individual luminaires - integral)

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 09 33 Lighting Control Systems
 - 2. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 REFERENCES

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products
- B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement
- C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- D. NFPA 70E - National Electrical Safety Code
- E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System
- F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products
- G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
- H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED

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- I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)
 - J. UL 924 - Standard for Emergency Lighting and Power Equipment
 - K. UL676 Standard for Underwater Luminaires and Submersible Junction Box
 - L. Project site classification as defined in IESNA RP-33 LZ3.
- 1.4 SUBMITTALS
- A. Submit product data under provisions of Section 260500.
 - B. Basic Requirements of Submittal:
 - 1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
 - 2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
 - 3. Include outline drawings, support points, weights, and accessory information for each luminaire.
 - 4. Submit manufacturer origin of LED chipset and driver.
 - C. LED Lighting - Performance Testing Submittal (when requested by Architect/Engineer):
 - 1. IESNA LM-79: Include photometric report for the latest generation system being furnished. Provide name of independent testing laboratory, report number, date of test, luminaire series/model number, input wattage, and light source specifications.
 - 2. IESNA LM-80: Measuring Lumen Maintenance of LED Light Sources.
 - D. LED Lighting - Control Compatibility Submittal:
 - 1. Submit lighting control capability data for each LED luminaire. The submittal shall clearly identify device data proposed by the Contractor and approved by the luminaire manufacturer for dimming, switching, addressable, wireless, and similar control characteristics.
 - E. Submit Design Lights Consortium (DLC) information for each luminaire type.
 - F. Submit utility rebate forms where offered at project location. Submit completed rebate forms within 30 days of Substantial Completion.
- 1.5 EXTRA STOCK
- A. Provide extra stock under provisions of Section 260500.
 - B. LED Light Engines or Modules: 3 percent of quantity installed, minimum one (1) of each size and type of field replaceable light engine or module. Provide field replacement installation instructions.
 - C. Lenses: Three (3) percent of quantity installed, minimum one (1) of each size and type.

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- D. LED Drivers: 3 percent of quantity installed, minimum one (1) of each size and type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Section 260500.
- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.
- C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.7 WARRANTY

- A. The warranty period begins at the date of Substantial Completion.
- B. LED Light Engines and Drivers:
 - 1. LED Drivers and Dimming Drivers: Five (5) years
 - 2. Light Emitting Diode (LED) Light Engines: Five (5) years
- C. Emergency Lighting Units and Exit Signs:
 - 1. Emergency Lighting Units: Three (3) year, non-prorated
- D. Emergency Drivers:
 - 1. Emergency LED Driver: Three (3) years
- E. Emergency Inverter for LED Light Engines:
 - 1. Emergency Inverter and Battery: Sealed nickel cadmium five (5) year, non-prorated.
- F. Automatic Load Control Relay (ALCR): Five (5) year
- G. Pole Finish: Three (3) year warranty of pole color and finish

1.8 REGULATORY REQUIREMENTS

- A. Conform to NFPA 101 for installation requirements.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.
- B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

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- C. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.
 - D. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified. Verify suspension length prior to submittal.
 - E. Painted reflector surfaces shall have a minimum reflectance of 90%.
 - F. All painted components shall be painted after fabrication.
 - G. Where indicated on drawings, provide wire guards for luminaires to protect against damage and vandalism. Wire guards shall be constructed of durable coated steel wire.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled. Provide ingress protection (IP) rating when scheduled.
- B. Provide low temperature LED drivers, with reliable starting to -20°F.
- C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.
- D. Exterior LED luminaires shall contain separate, easily accessible and replaceable Category C surge protection device.
- E. Where indicated on drawings, provide wire guards for luminaires to protect against damage and vandalism. Wire guards shall be constructed of durable coated steel wire.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

- A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70. Color temperature of the luminaires shall be as noted on the luminaire schedule. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.
- B. Refer to the luminaire schedule for color temperature and minimum color rendering index CRI requirements. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.
- C. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- D. Rated life shall be minimum of 50,000 hours at L70.
- E. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.
- F. Luminaire delivered lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.

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- G. LED luminaires shall be designed for ease of component replacement including modular replaceable boards or Zhaga sockets. Luminaires that are factory sealed and do not have field replaceable parts shall provide a 10-year warranty.
 - H. LED light engine shall have a maximum LLD of 0.85 at 50,000 hours at 25°C ambient.
 - I. LED Driver:
 - 1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 10%. Driver shall have a voltage fluctuation tolerance of +/- 10%.
 - 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
 - 3. Driver shall have a minimum of 50,000 hours rated life.
 - 4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.
 - 5. Driver shall be field replaceable without removal of the luminaire.
 - 6. Class A sound rating; inaudible in a 27 dBA ambient.
 - 7. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.
 - 1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:
 - a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
 - b. Luminaires 56 lbs or greater: Provide a minimum of four (4) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires. Support luminaire independent of the ceiling system.
 - c. Luminaires larger than eight square feet (8 ft²): Support luminaire independent of the ceiling system.
- B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.

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- C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
 - D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.
 - E. Provide seismic bracing of luminaires per IBC Chapter 16. Design pendant luminaires on a component seismic coefficient (Cc) of 0.67. Design vertical supports with a factor of safety of 4.0. Contractor shall verify the Seismic Hazard Exposure Group and Performance Criteria Factor.
 - F. Install lamps in lamp holders of luminaires.
 - G. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.
 - H. Recessed luminaires and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.
 - I. Industrial Pendant Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between driver and structure. Provide safety chain between reflector and driver.
 - J. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.
 - K. Embedded Luminaire Poles: Depth as indicated. Install plumb.
 - L. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.
- 3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES
- A. The Contractor shall provide temporary construction lighting per the requirements of Division 1.
 - B. The project luminaires shown on the construction documents shall not be used for temporary construction purposes without providing a plan for Owner approval that addresses energy and luminaire operating hours.
- 3.3 RELAMPING
- A. Replace failed LED light engine modules or arrays at completion of work.
- 3.4 ADJUSTING AND CLEANING
- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
 - B. Touch up luminaire and pole finish at completion of work.

3.5 OWNER TRAINING

- A. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion, with the Owner's Representative.
- B. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.6 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

END OF SECTION 265119

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SECTION 280500 - BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make the portion of the security systems a finished and working system.
- C. Separate contracts will be awarded for the following work.
- D. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- E. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- F. Description of systems include but are not limited to the following:
 - 1. Fire detection and alarm.
 - 2. Low voltage security wiring (less than +120VAC) as specified and required for proper system control and communications.
 - 3. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
 - 4. Firestopping of penetrations of fire-rated construction as described in Division 7.

1.3 WORK SEQUENCE

- A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during non-occupied hours. The Owner shall reserve the right to set policy as to when restricted construction hours will be required.
- B. Itemize all work and list associated hours and pay scale for each item.

1.4 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
 2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
 3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.
 4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.
- C. General:
1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to security systems including back boxes, conduit, power wiring and low voltage security wiring. The prime contractor is responsible for all divisions of work.
 2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.
 3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.
 4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.
 5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Electrical Busduct

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- e. Cable Trays, including 12" access space
 - f. Sprinkler Piping and other Piping
 - g. Conduit and Wireway
 - h. Open Cabling

D. Electrical Contractor's Responsibility:

- 1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
- 2. Assumes all responsibility for providing and installing cable tray.
- 3. Responsible for Security Systems grounding and bonding.
- 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:

- 1. Assumes all responsibility for the low voltage security wiring of all systems, including cable support where open cable is specified.
- 2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
- 3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
- 4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of security equipment which is required to be bonded to the telecommunications bonding system.
- 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

- 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

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- d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
- 2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
 - 3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.
- B. Participation:
- 1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 - 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 - 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.
- C. Drawing Requirements:
- 1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

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2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.
3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.
5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
 - a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
6. Conform to all requirements of the State of Missouri Codes, Laws, Ordinances and other regulations having jurisdiction.
7. Conform to all published standards of University of Missouri.
8. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
9. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
10. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
11. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
12. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

B. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

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6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
 7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.
- C. Examination of Drawings:
1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
 2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
 3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
 4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
 5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
 6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.
- D. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing Revit.
 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
 4. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
 5. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
 6. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
 7. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

E. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.7 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.8 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
 1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents

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- i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

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6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
 16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 28 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 28 XX XX.description.YYYYMMDD

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5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.9 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
 - a. Security systems:
 - 1) Surveillance
 - 2) Access control
 - 3) Intrusion
 - 4) Infant abduction

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.11 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:
 - 1. Firestopping, including mechanical firestop systems.

1.12 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.13 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.14 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.
- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

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- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.15 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.16 CONTINGENCY

- A. Include in the Base Bid a contingency of 10 percent to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.17 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 260533. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.
- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

- A. General:
 - 1. Refer to specific Division 28 sections for further requirements.
 - 2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

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3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
 4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of this section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
2. Submitted bound copies of approved shop drawings.
3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

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4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
 5. Submitted testing reports for all systems requiring final testing as described herein.
 6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
 7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div28.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

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- C. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
 4. Copy of final approved test and balance reports.
 5. Copies of all factory inspections and/or equipment startup reports.
 6. Copies of warranties.
 7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 8. Dimensional drawings of equipment.
 9. Capacities and utility consumption of equipment.
 10. Detailed parts lists with lists of suppliers.
 11. Operating procedures for each system.
 12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 13. Repair procedures for major components.
 14. List of lubricants in all equipment and recommended frequency of lubrication.
 15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- F. Refer to the individual specification sections for minimum hours of instruction time for each system.
- G. Operating Instructions:
 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.

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2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

- A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record actual routing of all conduits sized 2" or larger.
- E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

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- F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All CCTV cameras, mounts, cabling and all headend equipment are installed, programmed and operational.
4. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

END OF SECTION 280500

SECTION 283100 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm and detection systems.

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.
- B. Section 280537 - Distributed Antenna System (DAS) for Public Safety Networks.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.
- B. Installer: A factory-authorized Electrical or Security Contractor licensed with the State and local jurisdiction with five years' experience in the design, installation, and maintenance of fire alarm systems by that manufacturer.
- C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 3. This person's name and certification number shall appear on the start-up and testing reports.

1.4 REFERENCES

- A. ASME A17.1 - Safety Code for Elevators and Escalators
- B. NFPA 20 - Standard for Centrifugal Fire Pumps
- C. NFPA 70 - National Electrical Code (NEC)
- D. NFPA 72 - National Fire Alarm and Signaling Code
- E. NFPA 101 - Life Safety Code
- F. UL 2017 - General Purpose Signaling Devices and Systems
- G. UL 217 / 268 - Standard for Smoke Alarms / Smoke Detectors for Fire Alarm Systems
- H. UL 2572 - Control and Communication Units for Mass Notification Systems
- I. 2021 Fire Code

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260500 and as noted below.
 - 1. Failure to comply with all the following and all the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.
 - 2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.
- B. Provide product catalog data sheets as shop drawings.
 - 1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings, but required for the operation of the system.
 - 2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.
 - 3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.
- C. Submit CAD Floor Plans as Shop Drawings:
 - 1. The complete layout of the entire system, device addresses, auxiliary equipment, and manufacturer's wiring requirements shall be shown.
 - 2. Indicate the precise routing of notification appliance circuits under the provisions of circuit survivability. Refer to "Wiring" under Part 3 - Execution of this specification section for requirements.
 - 3. A legend or key shall be provided to show which symbols shown on the submittal floor plans correspond with symbols shown on the Contract Documents.
- D. About all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.
- E. Provide installation and maintenance manuals under provisions of Section 260500.
- F. Submit manufacturer's certificate that system meets or exceeds specified requirements.
- G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.
- H. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.
- I. When required to comply with local or state regulatory reviews, the fire alarm submittal shall have a NICET Certification of the state in which the project is completed. NOTE: The Architect/Engineer cannot stamp and seal submittal drawings not prepared under their supervision.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.
 - a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.
 - b. Notification Appliances: Speakers, speaker strobes, and strobes.
 - 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet minimum of one (1) set each and shall turn over to the Owner upon completion.
 - 3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 260500.
- B. Store and protect products under provisions of Section 260500.

1.8 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.9 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.

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- D. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 260500.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.
- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.11 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 260500.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.12 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

1.13 ANNUAL INSPECTION/TESTING AND SERVICE CONTRACT

- A. Provide cost to furnish service, inspect, and test all devices of the fire alarm system per the requirement of NFPA for one (1) year, starting one year after the Date of Substantial Completion. Submit written reports of inspection testing per NFPA 72, Chapter 14.
- B. Provide an alternate cost for a complete inspection/testing and service/maintenance contract for the fire alarm system for one (1) year two (2) years, starting one year after the Date of Substantial Completion. Submit sample contract terms and conditions for review with shop drawings.
- C. The Owner may enter into a contract directly with the vendor after shop drawing submittals. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Johnson Controls - Simplex
- B. Notifier by Honeywell
- C. Gamewell - FCI

2.2 FIRE ALARM PATHWAY CLASS AND SURVIVABILITY LEVEL

- A. Pathway Class:
 - 1. Pathway Class B: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.
- B. Pathway Survivability Level:
 - 1. Pathway Survivability Level 0: Circuits have no requirements for pathway survivability beyond the requirements of the code.

2.3 SIGNALING LINE CIRCUIT DEVICES

- A. Combination Devices: Subscripts identify combination type devices when applicable. Contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device.
- B. Signal Line Device(s):
 - 1. Subscripts: Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device type as follows:
 - 1) W = Weather Proof
 - 2) WG = Wire guard is required
 - 3) Candela Ratings:
 - a) ## = 15 Candela, 30 Candela; 75 Candela; 110 Candela; 177 Candela
 - b) CD = NICET designer shall select Candela rating as required to provide full coverage of the space.
 - b. Sequence of operation as follows:
 - 1) A = Atrium
 - 2) CR = Computer Room
 - 3) D = HVAC Control
 - 4) DH = Door Hold Release
 - 5) FD = Fire Door Release
 - 6) SW = Stairwell

C. FA-120; Smoke Detectors:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) Blank = Photoelectric
 - 2) CO = Combination Smoke / Carbon Monoxide
 - 3) H = Combination Smoke / Heat Detectors
 - 4) ID = In-Duct Detector
2. (BLANK) Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
3. (CO) Combination Smoke / Carbon Monoxide:
 - a. Multi-criteria sensor for photoelectrical smoke sensing and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The combined photoelectric smoke detection CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.
 - c. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
 - d. The detector shall use only one address on the SLC.
 - e. CO sensor cartridge element shall be field replaceable.
4. (H) Combination Smoke / Heat Detector:
 - a. Multi-criteria sensor for photoelectrical smoke sensing and rate of rise heat detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The detector shall use only one address on the SLC
5. (IN) In-Duct Smoke Detectors:
 - a. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
 - b. Analog Ionization Type Sensor: Shall use the dual chamber ionization principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
 - c. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.
 - d. Each smoke detector shall connect directly to an SLC loop.
 - e. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided to match the duct application. Provide a two-piece head/base design.
 - f. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
 - g. Provide a remote LED indicator device (FA-240/241), mounted in ceiling directly below detector with a single-gang faceplate labeled: Duct Smoke Detector.

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6. Each smoke detector shall connect directly to an SLC loop, unless listed as stand alone.
 7. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.
 8. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
 9. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.
 10. A test means shall be provided to simulate an alarm condition.
 11. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.
 12. Audible Sounder Detector Base for Sleeping Room Applications:
 - a. The audible base shall sound an alarm in the local room in UL2017 operation and UL484 for general evacuation. The unit shall be programmable by the main control panel for the duration of operation.
 - b. The audible sounder base shall sound Temporal 3 (fire) or Temporal 4 (CO alarm) and be at 75 dB at 10 feet.
- D. FA-121; Gas Detectors:
1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) CO = Carbon Monoxide
 2. (CO) Analog Carbon Monoxide Type Sensor.
- E. FA-122; Duct Smoke Detectors, Sampling Tube Type:
1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) # = Equipment or system
 - b. Duct-type smoke detectors shall use the same analog photoelectric sensor technology, with the same features specified for standard smoke detectors, except with additional features as specified below.
 - c. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where the detector housing is larger than the duct height, Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer's recommendations.
 - d. Provide a remote alarm LED indicator device (FA-241) or (FA-242) if detector is not visible from a floor-standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.

F. FA-140; Heat Detectors:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) Blank = Combination Rate of Rise / Fixed Temp
 - 2) F = Fixed Temp
2. (BLANK) Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135°F and at 15°F per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.
 - a. MRI Procedure Rooms: Analog fixed temperature type sensor suitable for magnetic environments, factory programmed to alarm at 135°F or as specified on drawings. Sensor shall report to the fire alarm control panel via an addressable relay installed outside the magnetic shield. Coordinate the magnetic filter for the fire alarm conductors with the MRI shield vendor.
3. (F) 200°F fixed temperature. Provide a remote addressable monitor module to interface with addressable system as shown on the plans.
4. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
5. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof detectors are used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.
6. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.
7. Provide a remote LED indicator device if detector is not visible from a floor-standing position.
8. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.
9. A test means shall be provided to simulate an alarm condition.
10. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.

G. FA-141; Heat Detector, Linear Wire Type:

1. Linear heat detector with addressable monitor module (FA-160) and line type heat detector conductor routed as shown on drawings.
2. Manufacturer: Protectowire, fire alarm manufacturer.
3. Labeling: Provide signage identification indicating existence of linear heat detectors at the entrances of areas protected.

H. FA-160; Monitor Modules:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.

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- a. Device types as follows:
 - 1) Blank = Refer to Plans
 - 2) KB = Knox Box Monitor
 - 2. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits. Contractor Option: Use an interface module (2-wire operation) for Style B circuits connected to normally-open dry contacts, such as a flow switch.
 - 3. The module shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware shall be provided.
 - 4. The module shall supply the required power to operate the monitored device(s).
 - 5. The module shall provide address setting means using rotary decimal or DIP switches.
- I. FA-161; Addressable Control Module:
- 1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) Blank = Refer to Plans
 - 2) DH = Door Hold Open
 - 3) PD = Hold Open Override
 - 2. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional child relay(s), as required, rated for the electrical load being controlled (Contractor to match voltage, amps, etc.).
 - 3. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.
 - 4. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.
 - 5. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.
- J. FA-280; Isolation Module:
- 1. Provide fault isolation modules or isolator detector base capable of isolating and removing the fault from Class A or Class X addressable loop data circuits while allowing the remaining data loop to continue operation. Provide a minimum of two isolation modules or bases and between every 15 devices.
- 2.4 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS
- A. FA-250; Smoke and Fire/Smoke Damper Controller:
- 1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - 2. Device types as follows:
 - a. + = Indicates equipment system associated with smoke or fire/smoke damper.

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3. Motorized type, 120 VAC, furnished and installed by MC. Fire alarm control and power connections by EC. A subscript is used to identify the device with a specific air handler or zone for its sequence of operation. Refer to the Fire Alarm Operation Matrix on the drawings and the sequence of operation descriptions in this specification section for additional requirements.
 4. The EC provides:
 - a. Fire alarm control and power connections by EC.
 - b. Fire alarm addressable control module (FA-161) located within 5 feet of smoke damper.
 - c. Smoke detection, selected by NICET designer based on duct size, ventilation airflow, and specific field conditions. Detector shall be mounted within 5 feet of smoke damper. Approved options include:
 - 1) Smoke Detector (FA-120) (ID) In-Duct Detector. In-duct smoke detector in ducts less than 18". Detector shall be listed for use in HVAC ductwork.
 - 2) Duct Smoke Detector (FA-122). Sampling type duct detector (FA-122) in ducts 18" and larger.
 - d. Remote indicator (FA-241) or Remote Indicator with test switch (FA-242) mounted in visible location. Refer to drawings for mounting location or verify location with engineer when not shown.
 - e. The smoke damper shall close upon activation of the detector, and a supervisory signal shall be sent to the fire alarm control panel. Refer to the Fire Alarm Operation Matrix and these specifications for complete requirements.
 5. Provide an enclosure and equipment for interface of dampers with the fire alarm system and temperature control system.
- B. FA-260; Flow Switch:
1. (FA-260) Connection to flow switch to monitor fire protection flow switch or discharge output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.
 2. Provide a dedicated monitor switch for each sprinkler flow switch.
- C. FA-261; Tamper / Monitor Switch:
1. (FA-261) Connection to monitor switch to monitor fire protection system supervisory switches or output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.
 2. Tamper switches in the same room or system may be monitored by a single monitor switch when shown grouped on the plans.
 3. Subscripts: Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 4. Device types as follows:
 - a. Blank = Refer to Plans
 - b. PIV = Post Indicator Valve
 5. (PIV) Post Indicator Valve. Connection to post indicator valve for sprinkler system supervisory notification. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC. Provide surge protection device as recommended by the fire alarm system manufacturer on line entering/leaving the facility.

2.5 WIRE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

2.6 WIRING

- A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with the Electrical Code for power-limited fire alarm signal service.
- B. Fire Alarm Cable:
 - 1. Manufacturers:
 - a. Comtran Corp.
 - b. Helix/HiTemp Cables, Inc.
 - c. Rockbestos-Suprenant Cable Corp.
 - d. West Penn Wire/CDT.
 - e. Radix.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

- A. General:
 - 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
 - 2. The GUI/graphic annunciator shall display audible and visual alarms. The device activated shall be immediately displayed on a CAD floor plan at approximately 1/8" scale. Visual indication shall further indicate the device by utilizing an easily recognized color change of the symbol. The use of flashing symbols is encouraged.
 - 3. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:
 - 1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder, and annunciator locations.
 - 2. A local signal in the control panel shall sound.
 - 3. The LCD display shall indicate all information associated with the condition, including the name of the item, type of device and its location within the protected premises.
 - 4. history storage equipment shall log the information associated with the fire alarm control panel (FAP) condition, along with the time and date.
 - 5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital communicator.

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6. Transmit the appropriate signal (supervisory, trouble, alarm) to the building automation system via addressable relays tied to contact monitors on the system.
- C. Audible Alarms Sequence:
1. Audible alarms throughout the building shall sound.
 2. Audible alarms within the floor or fire/smoke compartment where the emergency signal originated and in adjacent areas shall sound.
 3. Separate voice announcements shall be played in different fire compartments depending on proximity to the device that initiated the alarm. Refer to the requirements above for the Voice Command Center programming.
- D. Visual Alarms Sequence:
1. Visual alarms throughout the building shall flash.
 2. Visual alarms within the floor or fire/smoke compartment where the emergency signal originated floors shall flash.
- E. Clean Agent Release Sequence:
1. The fire alarm system shall utilize an addressable relay to signal the clean agent release panel to activate upon initiation of alarm in two zones of detection.
 2. Where there are multiple clean agent zones, a separate addressable relay shall be provided for each zone, and the system shall be programmed to signal only the zone that covers the area of the fire. Coordinate with the clean agent system installer.
- F. HVAC System Sequence:
- G. Smoke Damper Control Sequence:
1. The fire alarm system shall utilize an addressable relay to open the power connection to smoke or fire/smoke dampers and allow them to close. Coordinate other requirements with damper installer.
 2. Where a damper is in a main air duct, where closure of that single damper will entirely block airflow in the duct system, the smoke damper sequence shall also initiate the AHU and mechanical fan shutdown sequence for the affected unit.
 3. The AHU and mechanical fan shutdown sequence shall be initiated only when ALL the dampers associated with that unit or mechanical fan are closed. Otherwise, the AHU or mechanical fan shall continue to serve other areas.
 4. Smoke and fire/smoke dampers located in branch ductwork shall be closed individually or in groups, as identified on the plans.
 5. All smoke and fire/smoke dampers shall be closed throughout the building.
- H. AHU and Mechanical Fan Shutdown Sequence:
1. The fire alarm system shall utilize addressable relays to de-energize all AHU motor controllers and mechanical fans. Coordinate other requirements with HVAC installer.
 2. The fire alarm system shall directly shut down the AHU or mechanical fan through the local HVAC control device (i.e., variable frequency drive or motor starter).
 3. Where a facility has more than one AHU or mechanical fan, each shall be shutdown individually based on input from initiation devices in the area served by the unit or designated for each air distribution system.
 4. All AHUs and mechanical fans shall be shutdown simultaneously throughout the building.

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- I. Ceiling Fan Shutdown Sequence:
1. The fire alarm shall utilize an addressable relay to de-energize the ventilation ceiling fan and controller. Coordinate the connection to the fan shutdown contacts on the fan controller or interrupt the power circuit with the addressable relay.
- 3.2 INSTALLATION
- A. Install system in accordance with manufacturer's instructions and referenced codes.
- B. Fire Alarm Control Panel:
1. Install the control panel where shown on the drawings.
 2. All expansion compartments, if required, shall be located at the control panel.
 3. Install the voice command center and fire command center in the location as indicated on the drawings. This location should be primary fire department "attack" location. Coordinate with the local fire department prior to submitting shop drawings.
 4. The fire alarm voice prerecorded messages shall be verified by the Contractor, as approved by the Owner, prior to the shop drawing submittal process.
- C. Devices:
1. General:
 - a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
 - b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
 - c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
 - d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall adjust location of device so that new location meets all requirements in NFPA 72 and all applicable building codes.
 2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.
 3. Protection of Fire Alarm System:
 - a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.

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4. Analog Smoke and Heat Detectors:
 - a. In elevator shafts and elevator equipment rooms, provide a heat detector for elevator shutdown within 2' of every sprinkler head. Coordinate with fire protection contractor.
 5. Duct-type Analog Smoke Detectors:
 - a. Duct-type analog smoke detectors shall be installed on the duct where shown on the drawings and details. The sampling tubes shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.
 - c. Duct-type detectors shall be installed according to the manufacturer's instructions.
 6. In-Duct Analog Smoke Detectors:
 - a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.
 7. Heat Detector, Linear Wire Type:
 - a. Install detection wire within 20 inches of the underside of building roof, floor, or as recommended by the manufacturer.
 - b. The protected area shall not exceed 4,000 square feet per zone. Provide a separate zone for areas divided by fire/smoke rated walls.
 8. Manual Pull Stations:
 - a. Stations shall be located where shown and at the height noted on the drawings.
 9. Addressable Relays and Monitor Modules:
 - a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
 - b. All modules shall be mounted in or on a junction box in an accessible location.
 - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
 10. SLC Loop Isolation Modules:
 - a. Isolation modules shall be installed to limit the number of addressable devices that are incapacitated by a circuit fault.
 - b. Install all Isolation Modules within the fire alarm control panel, unless otherwise indicated on the drawings. Refer to the fire alarm riser diagram for requirements. Refer to the floor plans for areas served by separate isolation modules.
 11. Notification Appliance Devices:
 - a. Devices shall be located where shown on the drawings.

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- b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.
 - c. Where ceiling mounted visual alarm devices or combination audio/visual alarm devices are shown where the ceiling is greater than 30'-0" high, they shall be stem mounted so that the entire unit is below 30'-0". This does not apply to audio-only alarm devices.

D. Annunciators:

- 1. Color Graphics Annunciation System: The annunciator shall be installed with custom graphics software showing the floor plan of the entire building and shall include a close approximation of the location of all devices in the system. The annunciator shall be located approximately where shown on the drawings as directed by the Owner. Each smoke compartment zone, (refer to architectural drawings) as a minimum, shall be on a single screen. A screen shall be created depicting an overall plan indicating the entire facility and the quantity of floors or zones that will clearly indicate the area(s) the alarm(s) are being reported.
- 2. Remote Annunciators: The annunciators shall be located where shown on the drawings and approved by the fire marshal.

E. Wiring:

- 1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
- 2. Refer to Identification Section 260513 for color and identification requirements.
- 3. Wiring shall be installed in conduit from device to above accessible ceilings. Exposed plenum-rated cable (FPLP) shall be used above accessible ceilings supported every 4 feet or run in cable trays (if applicable) maintaining a minimum of 5-inches clearance from all lighting ballasts. Fire alarm cabling shall not be installed in the same bridge rings or cable trays designated for the cabling of other systems.
- 4. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 260513 for color and identification requirements.
- 5. Partial evacuation or relocation of occupants is the standard operating procedure for this facility in the event of an alarm. Therefore, all notification appliance circuits (NAC), including circuits serving NAC extender panels and other network communication circuits, must be installed and protected in accordance with the "circuit survivability" requirements described in NFPA 72. Contractor shall maintain the following:
 - a. NACs serving separate evacuation signaling zones shall be routed separately such that they are no less than 4 feet apart when run horizontally and 1 foot apart when run vertically. They may come simultaneously only within 10 feet of the control panel.
 - b. NACs passing through other evacuation signaling zone(s) shall be installed in conduit and routed through the 2-hour fire-rated chase(s) or enclosure(s) identified on the drawings.
 - c. NACs passing through other evacuation signaling zone(s) shall be Electrical Code classified CIC cable (Fire Alarm Circuit Integrity) installed in conduit. Provide CIC cable meeting UL requirements for 2-hour listing.
 - 1) The CIC cable system shall be installed in a conduit system meeting all requirements of its UL-listed installation system (conduit, boxes, connectors, etc.).
- 6. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 260513.

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7. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
 - a. Fire alarm temporal audible notification for all audio appliances.
 - b. Synchronization of all visual devices where two or more devices are visible from the same location.
 - c. Ability to silence audible alarm while maintaining visual device operation.
 - d. Emergency communication alert and textual visible appliance notification.
 8. Notification Appliance Circuits shall not span floors or smoke compartments. Refer to architectural drawings for smoke compartments.
 9. Signal line circuits connecting devices shall not span floors or 2-hour smoke compartments.
 10. Signal line circuits connecting devices shall be provided with an isolation module at each floor separation or as otherwise shown on the drawings.
 11. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- F. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.
1. Power Branch Circuit Conductors: In accordance with Section 260553.
 2. Signaling Line Circuit: Overall red jacket with black and red conductors.
 3. DC Power Supply Circuit: Overall red jacket with violet and brown conductors.
 4. Notification Appliance Circuit: Overall red jacket with blue and white conductors.
 5. Door Release Circuit: Gray conductors.
 6. Central Station Trip Circuit: Orange conductors.
 7. Central Station Fire Alarm Loop: Black and white conductors.
- G. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.
- H. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.
- 3.3 FIELD QUALITY CONTROL
- A. Field inspection and testing will be performed under provisions of Section 260500.
 - B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services under provisions of Section 260500.
- B. Include services of the manufacturer's software programmer to write initial custom-user program (for Color Graphics Annunciation System).
- C. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.
- D. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the actual room (signage) numbers that the Owner selects. Contractor and fire alarm manufacturer shall coordinate the actual room numbers as the Owner directs to identify each device. This list shall be a part of the floor plan record drawing to be turned in at the project closeout.
- E. Include the services to train up to three of the Owner's staff in operation, maintenance, and programming of the fire alarm system at the manufacturer's factory. Airfare and lodging expenses for the Owner's staff will be by the Owner.
- F. System Occupancy Adjustments: When requested by Owner within 12 months of date of Substantial Completion, provide on-site system adjustments to suit actual occupied conditions. For this purpose, provide up to two (2) site visits, four (4) hours each visit, outside normal occupancy hours.

3.5 SYSTEM TRAINING

- A. System training shall be performed under provisions of Section 260500.
- B. Minimum on-site training times shall be:
 - 1. System Operators: One (1) day.
 - 2. GUI Operation and Editing: One (1) day.
 - 3. Emergency Communication System: Four (4) hours.

END OF SECTION 283100

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