

PROJECT MANUAL FOR:  
**LABORATORY FOR INFECTIOUS DISEASE RESEARCH (LIDR) -  
Renovate West Animal Holding, Rms 144-149**

PROJECT NUMBER:  
**CP220692**

NIAID GRANT NUMBER:  
**1G20AI167403-01**

AT:  
UNIVERSITY OF MISSOURI  
COLUMBIA, MISSOURI

FOR:  
THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

Clark & Enersen  
Architect of Record  
2020 Baltimore Ave, Suite 300  
Kansas City, MO 64108  
816.474.8237

Clark & Enersen  
Mechanical, Plumbing, Electrical Engineer of Record  
2020 Baltimore Ave, Suite 300  
Kansas City, MO 64108  
816.474.8237


DATE:  
Issued for Contract Documents for Bid/Permit: December 18, 2023

I hereby certify that Drawing sheets G0.00, G1.00, G1.01, G1.20, A0.00, A0.01, A0.10, A0.11, A1.01, A1.10, A1.11, A2.10, A3.10, A4.10, LF0.10, LF1.00 and Specification sections 01 73 29 and 02 41 19 as well as specifications under Divisions 3, 4, 5,6,7,8,9,10,11, and 32 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: 




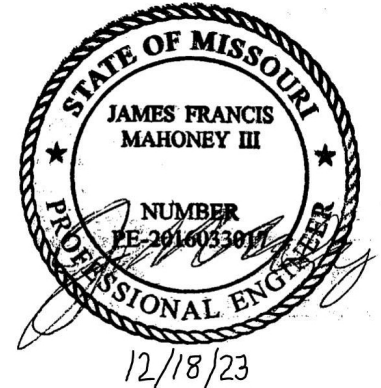
I hereby certify that Drawing sheets FS0.01, M0.00, M1.01, M1.02, M2.01, M2.02, M3.01, M3.02, M4.01, M5.01 and the Specifications under Divisions 21, 22, and 23 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: 



I hereby certify that Drawing sheets E0.00, E0.01, E0.11, E0.12, E1.01, E2.01, E2.02, E3.01, E4.01, E4.02 and the Specifications under Division 26 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: 



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**LABORATORY FOR INFECTIOUS DISEASE RESEARCH (LIDR) -  
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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:

LABORATORY FOR INFECTIOUS DISEASE RESEARCH –  
RENOVATE WEST ANIMAL HOLDING, ROOMS 144-149  
UNIVERSITY OF MISSOURI  
COLUMBIA, MISSOURI

PROJECT NUMBER: CP220692

CONSTRUCTION ESTIMATE: \$1,230,349 - \$1,367,054

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 6, 2023 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 Hadley Stolte with Clark & Enersen at (816) 474-8237 or [hadley.stolte@clarkenersen.com](mailto:hadley.stolte@clarkenersen.com). Questions regarding commercial conditions should be directed to Ashley Karpel at (573) 882-1349 or [karpela@missouri.edu](mailto:karpela@missouri.edu).

A prebid meeting will be held at 10:00 a.m., C.T., January 17, 2024 in the General Services Bldg., Room 194B, followed by a site walk-through.

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

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

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: January 9, 2024



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SECTION 1.A

BID FOR LUMP SUM CONTRACT

Date: \_\_\_\_\_

BID OF \_\_\_\_\_  
(hereinafter called "Bidder") a corporation\* organized and existing under laws of the State of \_\_\_\_\_

\_\_\_\_\_ ,  
a partnership\* consisting of \_\_\_\_\_ ,

an individual\* trading as \_\_\_\_\_ ,

a joint venture\* consisting of \_\_\_\_\_

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

TO: Curators of the University of Missouri  
General Services Building  
900 E. Stadium  
Columbia, MO 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by CLARK & ENERSEN, entitled "UNIVERSITY OF MISSOURI - LABORATORY FOR INFECTIOUS DISEASE RESEARCH – RENOVATE WEST ANIMAL HOLDING, RMS 144-149", project number CP220691, dated December 18, 2023 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

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

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

3. **BID PRICING**

a. **Base Bid:**

The Bidder agrees to furnish all labor, materials, tools, and equipment required to provide miscellaneous improvements through the existing Laboratory for Infectious Disease Research; all as indicated on the Drawings and described in these Specifications for 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 a 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: Addition of a new vehicle barrier gate system.

Base Bid: No new work.

Add alternate: New vehicle barrier gate.

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(2) Additive Alternate No 2: Additional Phase 2 epoxy floor area.

Base Bid: No new work.

Add Alternate: Demo and preparation of existing flooring/base; adding 2A and 2B epoxy floor.

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(3) Additive Alternate No. 3: Additional Phase 3 epoxy floor area.

Base Bid: Epoxy work as indicated for rooms indicated to be a part of Phase 1A, 2A, and 2B on sheet G1.01.

Add Alternate: Prepare existing floors and provide epoxy floor system to rooms indicated to be a part of Phase 3 on sheet G1.01. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(4) Additive Alternate No. 4: New roof over low-slope roof area.

Base Bid: No new work to existing low-slope roof area. Removing ceiling tile as required in room 102 and insulate roof drain pipe.

Add Alternate: Prepare existing low-slope roof area as indicated and provide new sloped standing seam metal roof over area as indicated and site work as required to connect drainage to the storm system. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(5) Additive Alternate No. 5: Motorized vehicle gate in security fence.

Base Bid: No new work to existing manual vehicle gates within the security fence.

Add Alternate: Remove existing manual vehicle gate in security fence as indicated, and provide motorized swing gate. Provide all required site work and relevant electrical and security electronics work as indicated. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

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 substantially complete within two hundred forty days (240) calendar days after receipt of aforementioned documents. Fifteen (15) calendar days have been

allocated in construction schedule for receiving aforementioned documents from Bidder.

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

d. Special scheduling requirements: refer to special conditions for special scheduling requirements

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, State
<b>Mechanical</b>	_____	_____
<b>Controls</b>	_____	_____
<b>Electrical</b>	_____	_____

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten (10%), with Service Disabled Veteran Owned Business (SDVE) of three percent (3%); and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten (10%) of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)  
SDVE PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)  
WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION: \_\_\_\_\_ percent (\_\_\_\_\_%)

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

7. BIDDER'S ACKNOWLEDGMENTS

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

b. Bidder agrees that bid shall not be withdrawn for a period of sixty (60) 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 of any group, association or corporation.

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

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race,

color, religion, sex or national origin in connection with performance of work.

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

9. BIDDER'S SIGNATURE

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

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
-------------------	------------------------------	--------------	-----------	-------------------------	-------------------

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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.)

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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.)

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

12. List banking references.

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- 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.

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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:

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Name:

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Title:

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Date:

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**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.

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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.

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

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

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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.

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6. List reasons for rejecting a diverse supplier/contractor which has been contacted.

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8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.

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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.

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

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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/](http://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](http://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](http://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](http://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](http://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. 12<sup>th</sup> Street  
Kansas City, MO 64106  
P: 816.513.1836  
W: [kcmohrd.mwdbe.com/?TN=kcmohrd](http://kcmohrd.mwdbe.com/?TN=kcmohrd)

Mid-States Minority Supplier Development Council  
505 N. 7<sup>th</sup> Street, Ste. 1820  
St. Louis, MO 63101  
P: 314.278.5616  
W: [midstatesdc.org](http://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](http://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](http://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](http://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](http://oa.mo.gov/sites/default/files/sdvelisting.pdf)  
[oeo.mo.gov/](http://oeo.mo.gov/)



## Minority Newspapers

Dos Mundos Bilingual Newspaper  
902A Southwest Blvd.  
Kansas City, MO 64108  
816-221-4747  
[www.dosmundos.com](http://www.dosmundos.com)

Kansas City Hispanic News  
2918 Southwest Blvd.  
Kansas City, MO 64108  
816/472-5246  
[www.kchispanicnews.com](http://www.kchispanicnews.com)

The Kansas City Globe  
615 E. 29th Street  
Kansas City, MO 64109  
816-531-5253  
[www.thekcglobe.com/about\\_us.php](http://www.thekcglobe.com/about_us.php)

St. Louis American  
4144 Lindell  
St. Louis, MO 63108  
314-533-8000  
[www.stlamerican.com](http://www.stlamerican.com)

St. Louis Chinese American News  
1766 Burns Ave, Suite 201  
St. Louis, MO 63132  
314-432-3858  
[www.scanews.com](http://www.scanews.com)

St. Louis Business Journal  
815 Olive St., Suite 100  
St. Louis, MO 63101  
314-421-6200  
[www.bizjournal.com/stlouis](http://www.bizjournal.com/stlouis)

Kansas City Business Journal  
1100 Main Street, Suite 210  
Kansas City, MO 64105  
816-421-5900  
[www.bizjournals.com/kansascity](http://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: \_\_\_\_\_

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University of Missouri

INFORMATION FOR BIDDERS

Page No.

1. Contract Documents..... FB/1  
2. Bidder's Obligation ..... FB/1  
3. Interpretation of Documents ..... FB/1  
4. Bids ..... FB/1  
5. Modification and Withdrawal of Bids..... FB/2  
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16. List of Subcontractors ..... FB/5

**1. Contract Documents**

**1.1** Drawings, specifications, and other contract documents, pursuant to work, which is to be done, may be obtained shown in the Advertisement for Bids and Special Conditions.

**2. Bidder Obligations**

**2.1** Before submitting bids, each bidder shall carefully examine the drawings and specifications and related contract documents, visit site of work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters which can affect the work or the cost thereof.

**2.2** Each bidder shall include in their bid the cost of all work and materials required to complete the contract in a first-class manner as hereinafter specified.

**2.3** Failure or omission of any bidder to receive or examine any form, instrument, addendum, or other document, or to visit the site and acquaint themselves with existing conditions, shall in no way relieve them from any obligation with respect to their bid or contract, and no extra compensation will be allowed by reason of anything or matter concerning which bidder should have fully informed themselves prior to bidding.

**2.4** Submission of bids shall be deemed acceptance of the above obligations and each and every obligation required to be performed by all of the contract documents in the event the bid is accepted.

**3. Interpretation of Documents**

**3.1** If any prospective bidder is in doubt as to the true meaning of any part of the drawings and specifications or contract documents, they shall submit a written request to the Architect for an interpretation.

**3.2** Requests for such interpretations shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

**3.3** Bids shall be based only on interpretations issued in the form of addenda mailed to each person who is on the

Architect's record as having received a set of the contract documents.

**4. Bids**

**4.1** Bids shall be received separately or in combination as shown in and required by the Bid for Lump Sum contract. Bids will be completed so as to include insertion of amounts for alternate bids, unit prices and cost accounting data.

**4.2** Bidders shall apportion each base bid between various phases of the work, as stipulated in the Bid for Lump Sum contract. All work shall be done as defined in the specifications and as indicated on the drawings.

**4.3** 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. Bidders shall be responsible for actual delivery of bids during business hours, and it shall not be sufficient to show that a bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a bid was somewhere in a university facility.

**4.4** The bidder's price shall include all federal sales, excise, and similar taxes, which may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City & State taxes shall not be included as defined within Article 3.16 of the General Conditions for Construction Contract included in the contract documents.

**4.5** Bids shall be submitted on a single bid form, furnished by the Owner or Architect. Do not remove the bid form from the specifications.

**4.6** No bidder shall stipulate in their bid any conditions not contained in the bid form.

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

## **5. Modification and Withdrawal of Bids**

**5.1** The bidder may withdraw their bid at any time before the scheduled closing time for receipt of bids, but no bidder may withdraw their bid after the scheduled closing time for receipt of bids.

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

## **6. Signing of Bids**

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

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

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

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

## **7. Bid Security**

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

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

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

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

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

## **8. Bidder's Statement of Qualifications**

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

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

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

## **9. Award of Contract**

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

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

## **10. Contract Execution**

**10.1** The Contractor shall submit within fifteen (15) days from receipt of notice, the documents required in Article 9 of the General Conditions for Construction Contract included in the contract documents.

**10.2** No bids will be considered binding upon the Owner until the documents listed above have been furnished. Failure of Contractor to execute and submit these documents within the time period specified will be treated, at the option of the

Owner, as a breach of the bidder's bid security under Article 7 and the Owner shall be under no further obligation to Bidder.

#### **11. Contract Security**

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

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

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

#### **12. Time of Completion**

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

#### **13. Number of Contract Documents**

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

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

#### **14. Missouri Products and Missouri Firms**

**14.1** The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities,

materials, supplies, and articles mined, grown, produced, and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations, or individuals. Each bidder submitting a bid agrees to comply with and be bound by the foregoing policy.

#### **15. SUPPLIER DIVERSITY**

##### **15.1 Award of Contract**

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

A 3-point Service-Disabled Veteran Enterprises (SDVE) bonus preference shall apply to this contract. The 3 bonus points can be obtained by a certified, Missouri based SDVE performing a commercially useful function, (as defined in Article 1 of the General Conditions of the Contract for Construction) either by submitting a bid directly to the Owner, or through the utilization of certified SDVE subcontractors and/or suppliers, whose participation provides at least 3% of the total bid amount. A firm does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of SDVE participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which SDVEs do not participate. The 3-point bonus preference shall be calculated and applied by reducing the bid amount of the eligible bidder by three (3) percent of the apparent low responsive bidder's bid. Based on this calculation, if the eligible bidder's resulting total bid valuation is less than the apparent low responsive bidder's bid, the eligible 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 eligible bidder's bid or the amount(s) of any contract awarded. The submitted bid form must include a minimum of 3% SDVE participation to obtain the three (3) point bonus. For every SDVE firm utilized, a completed AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION form shall be submitted to the Owner within 24 hours of the receipt of bids. Failure to do so may be grounds for rejection of the SDVE bonus preference.

##### **15.2 List of Supplier Diversity Firms**

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

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

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

##### **15.3 Supplier Diversity Percentage Goal**

The bidder shall have a minimum goal of subcontracting with diverse contractors, subcontractors, and suppliers, the percent

of contract price stated in the Supplier Diversity goal paragraph of the Bid for Lump Sum Contract Form.

#### **15.4 Supplier Diversity Percent Goal Computation**

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

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

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

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

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

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

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

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

#### **15.5 Certification by Bidder of Diverse Firms**

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

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

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

#### **15.6 Supplier Diversity Participation Waiver**

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

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

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

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

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

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

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

**15.6.2.6** The bidder's efforts to provide interested diverse firms with sufficiently detailed information about the drawings, specific actions and requirements of the contract, and clear scopes of work for the firms to bid on.

**15.6.2.7** 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 firms contacted a description of all information provided the diverse firms, and an explanation as to why agreements were not reached.

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

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

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

**15.6.2.11** 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.

## **15.7 Submittal of Forms**

**15.7.1** The bidder will include the Supplier Diversity Compliance Evaluation Form(s), or the Application for Waiver and other form(s) as required above in the envelope containing the "Bidder's Statement of Qualifications", see Article 8.

## **15.8 Additional Bid/Proposer Information**

**15.8.1** The Contracting Officer reserves the right to request additional information regarding Supplier Diversity participation and supporting documentation from the apparent low bidder. The bidder shall respond in writing to the Contracting Officer within 24 hours (1 workday) of a request.

**15.8.2** The Contracting Officer reserves the right to request additional information after the bidder has responded to prior 24-hour requests. This information may include follow up and/or clarification of the information previously submitted.

**15.8.3** The Owner reserves the right to consider additional diverse subcontractor and supplier participation submitted by the bidder after bids are opened under the provisions within these contract documents that describe the Owner's right to accept or reject subcontractors including, but not limited to, Article 16 below. The Owner may elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity goal.

**15.8.4** The Bidder shall provide the Owner information related to the Supplier Diversity participation included in the bidder's proposal, including, but is not limited to, the complete Application for Waiver, evidence of diverse certification of participating firms, dollar amount of participation of diverse firms, information supporting a good faith effort as described in Article 15.6 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 bid by the diverse firm.

## **16. List of Subcontractors**

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

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

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



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University of Missouri

# General Conditions

of the

# Contract

for

# Construction

December 2021 Edition

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## ARTICLE 1 GENERAL PROVISIONS

### 1.1 Basic Definitions

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

#### 1.1.1 Owner

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

#### 1.1.2 Contracting Officer

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

#### 1.1.3 Owner's Representative

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

#### 1.1.4 Architect

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

#### 1.1.5 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 work performed is at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier

Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

### 1.1.8 Supplier Diversity Definitions

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

#### .1 Minority Business Enterprises (MBE)

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

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

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

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

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

#### **.5 Disadvantaged Business Enterprise (DBE)**

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

U.S. citizens that are African Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBE's are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones.

To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed \$1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed \$22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

#### **1.1.9 Work**

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

#### **1.1.10 Approved**

The terms "approved", "equal to", "directed", "required", "ordered", "designated", "acceptable", "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 Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner's Representative or Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

#### **1.1.20 Public Works Contracting Minimum Wage**

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

#### **1.1.21 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 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 Architect before making the change.

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

**1.2.7** Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

**1.2.8** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be



performed and correlated personal observations with requirements of the Contract Documents. Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

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

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

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

### **1.3 Required Provisions Deemed Inserted**

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

## **ARTICLE 2 OWNER**

### **2.1 Information and Services Required of 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. Owner's lifting of Stop Work Order shall not prejudice Owner's right to enforce any provision of this Contract.

### **2.3 Owner's Right to Carry Out the Work**

**2.3.1** If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, 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, Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or

thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner.

## **2.4 Extent of Owner Rights**

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

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

## **ARTICLE 3 CONTRACTOR**

### **3.1 Contractor's Warranty**

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

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

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

**3.1.4** Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not

done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed the work necessary to bring the work into conformance with the Contract Documents at the Contractor's expense.

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

### **3.2 Compliance with Laws, 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 (collectively referred to as "Laws").

**3.2.2** Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

**3.2.3** All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are

included in the Contract Sum and shall be the Contractor's responsibility, as stated in 2.1.1 above.

**3.2.4** If the Contractor has knowledge that any Contract Documents are at variance with any Laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in 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 or corporation or joint venture the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

**3.4.3** The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance

with 3.17.2 of this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

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

**3.4.5** The Contractor shall establish and maintain a permanent 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. Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

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

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

- .1** All shutting of valves, switches, etc., shall be by the Owner's personnel.
- .2** Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.
- .3** The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.
- .4** The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

**3.4.8** The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any

disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a 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 its work or adjacent property and shall pay for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

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

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

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

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

**3.4.15** When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds

or ladders in place as may be required by the Architect or the Owner for examination 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 entity or other persons performing portions of the Work.

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

**3.4.18** The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are 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, Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. Contractor shall assume full responsibility for any damage to the property

comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

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

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

### **3.6 Review of Contract Documents and Field Conditions by Contractor**

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

**3.6.2** The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and Owner's Representative within twenty-four (24) hours. During the progress of work, Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said

location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with Owner's Representative and Architect. Contractor shall be responsible for the proper fitting of the Work in place.

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

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

### **3.7 Cleaning and Removal**

**3.7.1** The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than 6 inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards 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, Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the Work to the reasonable satisfaction of both the Owner's Representative and Architect.

### **3.9 Indemnification**

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

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

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

### **3.10 Patents**

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

**3.10.2** If the Contractor uses any design, device, or material covered by letters patent or copyright, he shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum 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 his 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 3.12.1.

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

- .1** Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other like information necessary for a complete evaluation of the substitution.
- .2** Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.
- .3** The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.
- .4** The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.
- .5** An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract 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 Owner's Representative in sufficient time to allow the Architect and Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's 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 Architect and Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

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

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

### **3.14 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 90 days of the Notice to Proceed. If Contractor believes that this milestone is unreasonable for any submittal, Contractor shall request an extension of this milestone, within 60 days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the 90-day milestone is unrealistic, and shall specify a date on which the submittal will be 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 Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by Architect and in such event, Contractor shall immediately remove all such materials from the Work site. When requested by Architect or Owner's Representative, samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

**3.14.8** 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. Contractor shall also coordinate each Submittal with other Submittals.

**3.14.10** 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 Contractor has satisfied its obligations under the Contract Documents with respect to Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

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

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

### **3.16 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.
  - (a)** Recommended spare parts including catalog number and name of local suppliers or factory representative.
  - (b)** Belt sizes, types, and lengths.
  - (c)** Wiring diagrams.
- .5** Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.
- .6** Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

### **3.16.2 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 RSMo § 144.062. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of RSMo § 144.062.

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

**3.17.5** The Owner shall not be responsible for any tax liability due to Contractor's neglect to make timely orders, payments, etc. or Contractor's misuse of the Project Tax Exemption Certificate. Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with RSMo § 144.062 and the terms of the Project Tax Exemption

Certificate. Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of Contractor's use of the Project Tax Exemption Certificate.

### **3.18 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 Architect's information Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

**3.18.2** 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 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, contractor shall comply with the following:

- .1** The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.
- .2** The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
- .3** Prior to submittal to the Owner's Representative for review, Contractor shall obtain full buy-in to the schedule from all major subcontractors, in writing if so, requested by Owner's Representative.
- .4** Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.
- .5** Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule

during the last month, and explain how the end date has been impacted by same.

- .6** The submission of the updated 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 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 3.17.3. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph 3.17.3 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

## **ARTICLE 4**

### **ADMINISTRATION OF THE CONTRACT**

#### **4.1 Rights of the Owner**

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

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

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

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

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

**4.1.6** The Owner does not allow smoking on university property.

#### **4.2 Rights of the Architect**

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

#### **4.3 Review of the Work**

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

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

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

#### **4.5 Claims for Concealed or Unknown Conditions**

**4.5.1** If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the

conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will 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, Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

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

#### **4.6 Claim for Additional Cost**

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

#### **4.7 Claims for Additional Time**

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

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

**4.7.2** If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the Anticipated Weather Day schedule in the Special Conditions. To be considered a weather day,

at least four 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 contract 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 contract 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 completion 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 this Article 4, and notwithstanding other requirements of the Contract, all Force Majeure events resulting in a delay

to the critical path of the project shall be administered as provided in Article 8.

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

#### **4.8 Resolution of Claims and Disputes**

**4.8.1** The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

**4.8.2** If a Claim has not been resolved, the Contractor shall, within ten 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's 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 Director of Facilities Planning and Development, University of Missouri, 109 Old Alumni Centers, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the claim at the meeting called by the UM System Contracting Officer.

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

## **ARTICLE 5 SUBCONTRACTORS**

### **5.1 Award of Subcontracts**

**5.1.1** Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The

Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

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

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

## **5.2 Subcontractual Relations**

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

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

forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

## **5.3 Contingent Assignment of Subcontract**

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

## **ARTICLE 6 SEPARATE CONTRACTS AND COOPERATION**

**6.1** The Owner reserves the right to let other contracts in connection with the Work.

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

**6.3** No Contractor shall delay another Contractor by neglecting to perform his work at the proper time. Each Contractor shall be required to coordinate his work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, 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 Owner's or other Contractor's property done by him or persons in his employ, through his or their fault or negligence. If any Contractor shall cause damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

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

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

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

## **ARTICLE 7 CHANGES IN THE WORK**

### **7.1 CHANGE ORDERS**

**7.1.1** A change order is a written instrument prepared by the Owner and signed by the Owner and Contractor formalizing their agreement on the following:

- .1** a change in the Work
- .2** the amount of an adjustment, if any, in the Contract amount
- .3** an adjustment, if any, in the Contract time

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

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

**7.1.4** The amount of adjustment in the contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

- .1** By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.
- .2** By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to

date on time and material change orders not yet finalized.

- .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 change order pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

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

- .1** Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.
- .2** Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars (\$1,000) in cost shall be supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.
- .3** Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly



rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

## **7.2 Construction Change Directive**

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

- .1** A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.
- .2** By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.
- .3** A method agreed to by both the Owner and the contractor with a mutually agreeable fee for overhead and profit.
- .4** In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the contract amount, the Owner, with the assistance of the architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

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

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

## **7.3 Overhead and Profit**

**7.3.1** Overhead and Profit on Change Orders shall be applied as follows:

- .1** The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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 his forces
  - 5% To first tier Subcontractor on Work performed by his Subcontractor
- .3** The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.
- .4** Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier subcontractors. Overhead and profit shall be shown separately for each subcontractor of any tier and the Contractor.
- .5** On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.
- .6** The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:

Overhead and Profit

  - 7.5% Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased
  - 2.5% Credit to the Owner from the Contractor on Work performed by other than his forces
  - 2.5% Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

## **7.4 Extended General Conditions**

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

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

**7.4.3** If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

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

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

## **7.5 Emergency Work**

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

## **ARTICLE 8 TIME**

### **8.1 Progress and Completion**

**8.1.1** Contractor acknowledges and agrees that time is of the essence of this Contract

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

**8.1.3** The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or 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, Contractor shall be liable for such liquidated damages as set forth in Paragraph 8.3

**8.2.2** All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, 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 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 Contractor provide the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. 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 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 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 Contractor or by acts or omissions of Contractor or its Subcontractors of any tier or delays beyond the control of both Owner and Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. 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, Contractor shall only be entitled to its actual direct costs caused thereby and Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

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

### **8.3 Liquidated Damages**

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

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

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

## **ARTICLE 9 PAYMENTS AND COMPLETION**

### **9.1 Commencement, Prosecution, and Completion**

**9.1.1** The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. Contractor shall prosecute the Work with faithfulness and diligence, and the

Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

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

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

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

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

**9.1.5** Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the 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 Contractor represent and warrant that the person signing the Contract has the legal authority to bind Contractor to the Contract.

**9.1.6** Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the

Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

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

- .1 Reproducible progress and payment schedule
- .2 Contractor's Schedule of Values
- .3 List of material suppliers
- .4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.
- .5 Itemized breakdown of anticipated equipment rates (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. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). Contractor shall submit documentation for the Blue Book to support the rate being requested.

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

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

## **9.2 Contract Sum**

**9.2.1** The Owner shall compensate Contractor for all Work described herein, and in the Contract Documents the Contract

Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

### 9.3 Schedule of Values

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

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

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

### 9.4 Applications for Payment

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

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

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

**9.4.4** If approved in writing and in advance by Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below,

for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the work and incorporated into the work, except as noted below. For the purposes of this Article, Offsite is defined as any location not owned or leased by the Owner. Contractor shall submit a list of materials that they are requesting payment for offsite storage within 60 days of Notice 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 Contractor shall submit to the Owner's Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. Contractor shall also submit the location the material will be stored and the method of protection
- .5 The storage facility shall be subject to approval by the Owner's representative, shall be located within an acceptable distance of the project sites as established by the Owner's Representative and all materials for the Owner's project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of The Curators of the University of Missouri.
- .6 The Owner's representative shall be provided a minimum of two weeks' 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 and Bailment Agreement 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 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, Owner may, at its sole option issue joint checks to subcontractors who have presented evidence that it has not been paid in accordance with the Contract;
- .5 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .6 damage to the Owner or another contractor;
- .7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by Contractor;
- .8 Contractor's failure to comply with applicable Laws;
- .9 Contractor's or Subcontractor's failure to comply with contract Prevailing Wage requirements; or
- .10 Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

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

## **9.7 Progress Payments**

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

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

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

**9.7.4** Based on the Schedule of Values submitted by Contractor, Applications for Payment submitted by Contractor

shall indicate the actual percentage of completion of each portion of Contractor's Work as of the end of the period covered by the Application for Payment.

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

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

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

## **9.8 Failure of Payment**

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

## **9.9 Substantial Completion**

**9.9.1** Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 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 Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

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

## **9.10 Partial Occupancy or Use**

**9.10.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, 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 Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

## **9.11 Final Completion and Final Payment**

**9.11.1** Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, Owner's

Representative will return Contractor's Final Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

**9.11.2** The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

- .1** Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.
- .2** Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.
- .3** The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.
- .4** The acceptance by Contractor of its Final Payment, by check or electronic transfer, shall be and operate as a release of all claims of Contractor against Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of Owner arising out of the Work.

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

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

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

## **ARTICLE 10**

### **PROTECTION OF PERSONS AND PROPERTY**

#### **10.1 Safety Precautions and Programs**

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

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

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

#### **10.2 Safety Of Persons and Property**

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

- .1** students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;
- .2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor's Subcontractors of any tier; and
- .3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.



**10.2.2** The Contractor shall give notices and comply with applicable laws, 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 referred to in Article 10 caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's other obligations stated elsewhere in the Contract.

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

### **11.1 Insurance**

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

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

### **11.2 Commercial General Liability**

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

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

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

insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

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

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

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

### **11.3 Licensed for Use Vehicle Liability**

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

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

### **11.4 Workers' Compensation Insurance**

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

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

### **11.5 Liability Insurance General/Other Requirements**

**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 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 occurrence/\$1,000,000.00 aggregate. The insurance afforded by the policy shall meet the requirements of this Section 11.2 and Section 11.5 relating to CGL Policies, and without limiting the foregoing, shall be extended to cover the liability of "The officers, employees, and agents of The Curators of the University of Missouri", who shall be named as additional insureds therein, and this liability is assumed in writing by the Contractor's Consultant under the written Subcontract described herein. All insurance coverages procured by Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. Any insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier. The form and content of all insurance coverage provided by Contractor are subject to the approval of Owner. All required insurance coverages shall be obtained and paid for by Contractor. Any approval of the form, content or insurance company by Owner shall not relieve the Contractor from the obligation to provide the coverages required herein.

**11.5.2** All insurance 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 Contractor covering the additional insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

**11.5.3** All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. Contractor shall cause its insurance carriers to waive all rights of subrogation,

except for Workers' Compensation, against the Owner and its officers, employees and agents.

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

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

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

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

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

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

**11.5.10** By requiring the insurance set forth herein and in the Contract Documents, Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect Contractor, and such coverages and

limits shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

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

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

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

## **11.6 Builder's Risk Insurance**

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

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

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

**11.6.4** The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism,

malicious mischief, collapse, lightening, earthquake, flood, frost, water damage, windstorm and freezing.

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

**11.6.6** The insurance as required herein shall be maintained in effect until the earliest of the following dates:

- .1 the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;
- .2 the date on which final payment of this Contract has been made by Owner to Contractor; or
- .3 the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

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

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

## **11.7 Bonds**

**11.7.1** When the Contract sum exceeds Fifty Thousand Dollars (\$50,000), the Contractor shall procure and

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

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

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

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

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

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

**ARTICLE 12**  
**UNCOVERING AND CORRECTION OF THE**  
**WORK**

**12.1 Uncovering of the Work**

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

**12.1.2** If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, 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 Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by Architect or Owner's Representative, the Architect or Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, 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 12.2.2 shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

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

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

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

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

**12.3 Acceptance of Nonconforming Work**

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

**ARTICLE 13**  
**MISCELLANEOUS PROVISIONS**

**13.1 Written Notice**

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

**13.2 Rights and Remedies**

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

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

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

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

**13.3 Tests and Inspections**

**13.3.1** Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, 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, 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, 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, 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 Architect.

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

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

federal laws, rules and regulations applicable to subcontractors of government contracts including those relating to equal employment opportunity and affirmative action in the employment of minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706) and Executive Order 11758, and certain veterans (38 USC 4212 formerly [2012]) contracting with business concerns with small disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Government in such circumstances are incorporated herein by reference.

### **13.5 Supplier Diversity Goal Program**

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

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

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

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

**13.5.5** The Contractor and his subcontractors shall develop, implement, maintain, and submit in writing to the Director of Facilities Planning & Development, an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed "Affidavit for Affirmative Action" in the form as included in the Contract Documents. For the purpose of this section, an "Affirmative Action Program"

means positive actions to influence all employment practices (including, but not limited to, recruiting, hiring, promoting, and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. Such affirmative action program shall include:

- .1 A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination.
- .2 The identification of a person designated to handle affirmative action.
- .3 The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion, and discipline.
- .4 The exclusion of discrimination from collective bargaining agreements.
- .5 Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

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

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

**13.6.1** The Contractor shall pay workers employed in the execution of this contract in full each week and not less than the predetermined wage rates and overtime for work of a similar character that have been made a part of this Contract. These rates are determined by the University of Missouri Director of Facilities Planning and Development. The rates are based on wage rates published in the Annual Wage Orders of the Missouri Department of Labor and Industrial Relations (MDLIR). The Contractor is to use MDLIR 8 CSR 30-3.020; .030; .040, .060 in determining the appropriate occupational titles and rates for workers used in the execution of this contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Director of Facilities Planning and Development. The Contractor is responsible for the payment of the aggregate of the Basic Hourly Rate and the Total Fringe Benefits to the workers on the project. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable

commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in §290.210(5) RSMo 1994. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner. In the event the contract contains more than one wage determination the Contractor shall comply with both.

**13.6.2** The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll 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 10 days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within 24 hours of written notice. (If applicable, and required by Owner, the Contractor will demonstrate that the Contractor is enrolled and participating in a federal work authorization program with respect to the employees working in connection with this project.) 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. The contractor further agrees, in the event the records are not presented as requested, he will abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as liquidated damages for underpayment of wages. Falsification of the certified payroll records may

result in the debarment of the contractor or subcontractor from future work with the University.

**13.6.3** The acquisition of products or services is subject to the supplier's conformance to the rules and regulations of the President's Committee on Equal Employment Opportunity (41 CFR, Ch. 60).

**13.6.4** The Contractor shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3), which are incorporated herein by reference. In addition, the Weekly Statement of Compliance required by these Regulations shall also contain a statement that the applicable fringe benefits paid are equal to or greater than those set forth in the minimum wage decision.

**13.6.5** Contractor acknowledges that violation of the requirements of Article 13.6 result in additional costs to Owner, including, but not limited to, cost of construction delays, of additional work for Owner's staff and legal expense. The cost of Contractor's violation of the provisions of Article 13.6 would be and is difficult to determine and establish. In the event that Contractor fails to comply with the provisions of this Article 13.6, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of Fifty Dollars (\$50.00) per day per individual who is paid less than the applicable prevailing wage, to approximate the investigative cost resulting to the Owner for such violations. To approximate the delay costs, Owner shall be entitled to retain or recover from the Contractor, as liquidated damages and not as a penalty, the sum of One Hundred Dollars (\$100.00) per day for each day the Contract cannot be closed out and final payment made because of Contractor's failure to comply with the provisions of this Article 13.6. Such liquidated damages shall be collected regardless of whether the Work has been completed. The liquidated damages and other amounts set forth in this Article 13.6 shall be in addition to all other liquidated damages the Owner may be entitled as set forth in the Contract Documents.

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

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

**13.6.8** Contractor acknowledges and recognizes that a material factor in its selection by the Owner is the Contractor's willingness to undertake and comply with the requirements of this Article 13.6. If Contractor fails to comply with the provisions of this Article 13.6, Owner may, in its sole discretion, immediately terminate the Contract



upon written notice. The rights and remedies of Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

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

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

**13.6.11** Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request or demand that workers pay back, return, donate, contribute, or give any part, or all, of said workers wages, salary, or any thing of value, upon the statement, representation or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment. The exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization.

**13.6.12** No contractor or subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the prevailing wage rate as provided in contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record. Any employer not in compliance with this Article shall owe to the University double the dollar amount per hour that the wage subsidy, bid supplement, or rebate has reduced the wage rate paid by the employer below the prevailing wage rate for each hour that work was performed.

**13.6.13** Time and one-half overtime will be paid on all hours over 10 hours per day or 40 hours per week. The wage rate is the total of the “Basic Hourly Rate” plus “Total Fringe Benefits” or the “public works contracting minimum wage”. For all work performed on a Sunday or

Holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply. Holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

### **13.7 Records**

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

### **13.8 Codes and Standards**

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

- .1** ICC International Building Code and reference standards
- .2** ICC International Plumbing Code
- .3** ICC International Mechanical Code
- .4** 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. Contractor and 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** Contractor and Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between Contractor and Owner. Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

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

**13.9.5** Contractor agrees that Owner shall not be liable to Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by

Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

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

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

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

### **13.10 Certification**

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

**13.10.2** 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.

**ARTICLE 14**  
**TERMINATION OR SUSPENSION OF THE**  
**CONTRACT**

**14.1 Termination by Owner for Cause**

**14.1.1** In addition to other rights and remedies granted to Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

- .1 refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;
- .2 refuses or fails to supply sufficient or proper materials;
- .3 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .4 disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;
- .5 disregards the authority of the Owner's Representative, Architect, or 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 Contractor and Contractor's surety, and may:

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

**14.1.3** The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance

under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architects services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

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

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

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

**14.2 Suspension by the Owner for Convenience**

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

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

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

**14.3 Owner's Termination for Convenience**

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

**14.3.2** Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance

of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

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

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

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

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

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SECTION 1.E  
SPECIAL CONDITIONS

1. DEFINITIONS

a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing December 18, 2023 - CP220691 – “University of Missouri Laboratory for Infectious Disease Research- Renovate West Animal Holding, Rms 144-149”.

b. Architect

Clark & Enersen  
2020 Baltimore, Suite 300  
Kansas City, Missouri 64108  
816-474-8237 p.

c. Mechanical, Plumbing & Electrical Engineer

Clark & Enersen  
2020 Baltimore, Suite 300  
Kansas City, Missouri 64108  
816-474-8237 p.

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

2. SPECIAL SCHEDULING REQUIREMENTS

(1) Contractor will not have access to the construction area prior to Owner’s notice to proceed to perform any demolition or construction activities, unless notified otherwise by Owner’s Representative.

(2) Project sequence and inter-project dependencies must be maintained in successful bidder’s schedule. Schedule development shall include, but not limited to MU work activities of Controls, TAB, 3rd Party Commissioning, and Inspections and Testing.

(3) During the construction period all heating ventilation & air conditioning air distribution system components including but not limited to the air handler, supply & return duct, variable volume devices and dampers shall be protected from environmental contaminants including but not limited to dust, debris and fungi during transportation, installation and project activities prior to system start-up.

(4) Prior to start-up of the HVAC equipment/system, including but not limited to, make-up air units, air handling units, supply, return, and exhaust duct for any purpose, the construction project area shall be complete of all dirty work activities. The entire work area in which the system serves shall be thoroughly cleaned by the contractor.

(5) Owner has specific requirements for notifications regarding coordination and utility shut-downs and tie-ins. These are described further in Division 1

(6) Working Hours

- a) Normal working hours are defined as weekdays, 7:00 am to 5:00 pm.
- b) Night hours are defined as Monday thru Thursday after 5:00 pm and before 6:00 am.
- c) Weekend Hours are defined as after 6:00 pm Friday until 4:00 am Monday

(7) Owner has retained a 3rd party commissioning agent. Contractor shall allow for and incorporate commissioning agent's tasks into their construction schedule.

(8) Utility shut-downs, outages and tie-ins: All such work may be done during normal, night, and/or weekend hours. All such work shall be done continuously until fully restored. Contractor shall submit a written plan outlining the required shut-downs, outages, and tie-in at least fourteen (14) days prior to starting the work. Utility shut-downs shall be reviewed, coordinated and approved by the Owner's Representative. Utility outage request is available from owner and must be filled out by the contractor.

(9) Owner installed equipment provision: owner will complete connections of Owner supplied equipment as coordinated and approved by Owner's Representative.

### 3. SCOPE OF WORK

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

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

c. General Description of Work:

(1) Project consists of various renovation work throughout the existing Laboratory for Infectious Disease Research.

(2) Demolition shall consist of Door and wall modifications as described on Sheet A0.10. Demolition for Alternate 2 includes roof, parapet, and lighting protection modification for the existing low slope roof area as described on sheet A0.01 & E0.12. Demolition for Alternate 3 includes fence modification along with conduit routing for new motorized fence operator.

(3) Architectural work shall consist of new metal stud and acryloyl engineered polymer panels at the ABSL3 lab ceilings and walls along with epoxy flooring to create a new containment suite within the ABSL3 area. New epoxy flooring is also included in the Phase 2 area of the first floor. Existing

door masonry infill, new door openings in existing masonry walls. Per the alternates, additional epoxy flooring, new sloped roof work and a new motorized gate are also included.

- (4) Structural (included on Architectural documents) work shall consist of masonry support at new doors, support for new pneumatically-sealed door, the work required for the new sloped roof in add alternat 4.
- (5) Mechanical work shall include new ductwork, valves, diffusers, piping, plumbing and effluent decontamination plumbing along with the protection and reinstallation of work as required for the new containment suite within the ABSL3 lab area.
- (6) Electrical work shall include the reinstallation of existing fixtures and devices along with installation of new fixtures and devices as required for the new containment suite within the ABSL3 area. Per the alternates, the work required for new site security and access control.
- (7) Site work shall consist of work per the alternates, including site security adjustments to vehicle gates, and any storm work associated to the new sloped roof.
- (8) Fire Suppression work shall consist of work required for the updated layout of the containment suite within the ABSL3 lab.

#### 4. LOCATION

Work shall be performed under this Contract on campus of the University of Missouri - Columbia, at the Laboratory for Infectious Disease Research at 1020 East Campus Loop.

#### 5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. The Owner's Representative will furnish the Contractor a digital copy of executed Contract and a complete set of Drawings and Specifications in pdf format.
- b. Hard copy prints of any documents (bid or explanatory) will be printed at the Contractor's expense through a printer of their choosing.
- c. The Owner will furnish explanatory and changed drawings in pdf format to Contractor as issued during project.

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

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

d. The Contractor shall submit to the Architect 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.4).

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

## 7. NOTIFICATION

Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner's Representative. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

## 8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Drawings and as

directed by the Owner's Representative.

b. Parking:

- (1) The Owner will issue Contractor two (2) service vehicle parking permits for use in University Parking lots.
- (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.

c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.

- 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: Existing toilet facilities within Project Limits or Restrooms designated by the Owner's Representative for use by the Contractor will be available. Failure of the Contractor to maintain restrooms in a clean condition will be cause for the Contractor's discontinued use of the restroom.
- 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 smoking any tobacco products, including e-cigarettes.
- g. Landfill: The Contractor shall not use the Owner's landfill. Dumping or disposal of excavated or demolition materials on Owner's property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner's property.
- h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.
- i. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is are prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from the Owner through a formal "Discharge to Sewer Request" form obtained at [Discharge to Sewer Request Form](#). The contractor should submit the form to the Owner's Representative, not to the Department of Environmental Health and Safety as the form indicates.
- j. All concrete waste material including washout water shall be totally contained and removed from the Owner's property.
- k. 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.

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

from Owner's Representative.

- (3) Use of ribbon, snow fence, chicken wire, rope, and wooden barricades as fencing is prohibited.
- (4) Fencing shall be maintained in an "as-installed" condition throughout the life of the project.
- (5) The Contractor may use used fencing provided it is in good condition and is satisfactory to the Owner's Representative.

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.
- (2) Plants within work area designated for removal shall be removed by Contractor.
- (3) 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.
- (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.

10. SUBSTITUTIONS and EQUALS

- a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12 .
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions and/or equal. Substitutions and/or equals submitted during the bidding period shall be received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of bids. To be considered, bidder's proposal shall include a complete description of the proposed substitution and/or equal and a comparison of significant qualities of the proposed substitution and/or equal with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution and/or equal shall be final.

- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.
- d. No substitutions and/or equal will be allowed for the following items:

<u>Item</u>	<u>Specification Section</u>
Lock Cylinders [Best]	08 71 00
Acryloyl Engineered Polymer Panels	06 83 15
Tech Electronics for Lenel and Aiphone System	
ACC (Alarm Communications Center) for Exterior Access Control	
Phoenix Controls	

11. CODES AND STANDARDS

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

12. PERMITS

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

13. SPECIALTIES

- a. Owner furnished topsoil: The Owner will place the topsoil and provide final grade. The contractor shall rough grade to the following specification:
  - (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

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

15. ROOF WARRANTY REQUIREMENT

- a. The Contractor shall submit, before the first progress payment, a copy of University of Missouri Roof System Manufacturer's Certification, which shall be manually signed by an authorized representative of Manufacturer of each proposed roofing system. Certification shall have original signature.
- b. 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 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.
- c. 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.
- d. The Roofing contractor or subcontractor shall provide the Owner with an Application for a Roof Warranty.

16. 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.

17. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF QUALIFICATIONS – NOT USED

18. MODIFICATIONS TO GENERAL CONDITIONS – NOT USED

19. PROJECT SCHEDULING

The project scheduling specification for the project are included immediately after the

Special Conditions. For this project the Contractor shall meet the following scheduling requirements.

Option 3: Contractor Schedule – Contractor is responsible for the schedule and he may provide with in-house personnel or hire a third party scheduling consultant. See Contractor Schedule Specification included in these documents.

## 20. PROJECT COORDINATION

- a. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
  - (1) Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - (2) Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
  - (4) Make provisions to accommodate items scheduled for later installation.
  - (5) Coordinate installation of owner furnished items including stored materials from previous project.

## 21. PROJECT PARTNERING – NOT USED

## 22. VALUE ENGINEERING – NOT USED

## 23. BUILDING SYSTEM QUALITY ASSURANCE

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



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

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

25. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES – NOT USED

26. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS

- a. The Contractor shall be represented at the site by a competent full-time superintendent during performance of subcontractor work 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 use a current industry standard (Primavera, Microsoft Project, etc.) project scheduling software which provides as a minimum: Critical paths, milestones, estimated and actual start and completion dates, scheduled vs. actual progress, and detailed task and subtask breakdown. The following schedules shall be provided as a minimum and kept current: Overall project schedule, four- (4-) week look-ahead, and two- (2-) week look-ahead.
- c. The Contractor shall provide the on-site superintendent with a handheld cellular telephone.

27. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the

right to reject a Bidder or major subcontractor whose rates exceed these stated rates.

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

## 28. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and 2014 NFPA 51B.

- a. Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
- a. The Contractor shall utilize the hot work permit decision tree and permit provided in the 2014 NFPA 51B for all Hot Work operations.
- b. 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.
- c. 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.
- d. 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.

## 29. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS

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.

- a. Only fully certified and evaluated Operators shall perform equipment operations. Operators in an "Operator in Training" status shall not be used.
- b. Submittal requirements:
  - 1. Submit copies of Operator certifications, licenses, and evaluations to the Owners Representative.

2. Submit Rigger and Signal Person qualifications to the Owners Representative.
3. Unless otherwise directed by the Owners Representative, submit a lift plan and conduct a lift coordination meeting for hoisting or crane operations for any lift greater than 2,000 pounds, or for any multi pick lift. Include protective measures for existing underground utilities, occupied buildings, pedestrian and vehicle pathways, adjacent buildings and overhead power lines. If the lift is to occur over an occupied building, provide a registered structural engineer's review and verification that the building can resist the impact of a dropped load for the intended lift. If evacuation of an occupied building is necessary to conduct the lift, the decision for building evacuation or scheduling the lift for off-hours will be determined by the Owner.

### 30. CONSTRUCTION WASTE MANAGEMENT

The goal of Construction Waste Management is to divert waste from the sanitary landfill. This shall be accomplished through reuse, recycling and/or salvage of non-hazardous construction and demolition debris to the greatest extent practical. Track and report all efforts related to reuse, recycling and/or salvage materials from the project (including clean fill material). Report all material types and weights, where material was diverted, type of diversion, documentation of diversion (eg: waste or recycling tickets), and applicable dates. In order to calculate the diversion percentage, total weights of all non-hazardous landfill material must be reported. This information shall be updated monthly utilizing the [Construction Waste Management Worksheet](#) provided here: [for MU] [http://www.cf.missouri.edu/cf/pdc/contractor\\_information](http://www.cf.missouri.edu/cf/pdc/contractor_information). Copies of all applicable receipts, tickets and tracking logs shall be uploaded to the Owner's information sharing website or reported as required by the Construction Project Manager.

(A summary worksheet is required prior to substantial completion).

### 31. WARRANTY WALKTHROUGH

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

END OF SECTION  
Option #3 – Contractor Schedule

1. GENERAL

- a) Time is of the essence for this contract.  
The time frames spelled out in this contract are essential to the success of this project. The University understands that effective schedule management, in accordance with the General Conditions and these Special Conditions is necessary to insure to that the critical milestone and end dates spelled out in the contract are achieved.
- b) Related Documents  
Drawings and general provisions of the Contract, including General Conditions' Article 3.17 shall apply to this Section.
- c) Stakeholders  
A Stakeholder is anyone with a stake in the outcome of the Project, including the University, the University Department utilizing the facility, the Design Professionals, the Contractor and subcontractors.
- d) Weather
  - (1) Contractor acknowledges that there will be days in which work cannot be completed due to the weather, and that a certain number of these lost days are to be expected under normal weather conditions in Missouri.
  - (2) Rather than speculate as to what comprises "normal" weather at the location of the project, Contractor agrees that it will assume a total of 44 lost days due to weather over the course of a calendar year, and include same in its as planned schedule. For projects of less than a calendar year, lost weather days should be prorated for the months of construction in accordance with the following schedule.
  - (3) Anticipated weather days for allocation/proration only. For projects lasting 12 months or longer, the 44 days per year plus whatever additional months are included will constitute normal weather.

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

2. SCHEDULING PROCESS

- a) The intent of this section is to insure that a well-conceived plan, that addresses the milestone and completion dates spelled out in these documents, is developed with input from all stakeholders in the project. Input is limited to all reasonable requests that are consistent with the requirements of the contract documents, and do not prejudice the Contractor's ability to perform its work consistent with the contract documents.  
Further, the plan must be documented in an understandable format that allows for each stakeholder in the project to understand the plan for the construction and/or renovation contained in the Project.
- b) Contractor Requirements
  - (1) Schedule Development  
Contractor shall prepare the Project Schedule using Primavera P3 or Oracle P6.

(2) Schedule Development

Within 4 weeks of the NTP, contractor shall prepare a schedule, in CPM format, that reflects the contractor's and each subcontractors plan for performing the contract work.

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

(3) Schedule Updates.

(a) Schedule Updates will be conducted once a month, at a minimum.

Actual Start and Finish dates should be recorded regularly during the month. Percent Complete, or Remaining Duration shall be updated as of the data date, just prior to Contractor's submittal of the update data.

(b) Contractor will copy the previous months schedule and will input update information into the new monthly update version.

(c) Contractor will meet with the Owner's Representative to review the draft of the updated schedule. At this meeting, Owner's Representative and Contractor will:

(i) Review out of sequence progress, making adjustments as necessary,

(ii) Add any fragments necessary to describe changes or other impacts to the project schedule and

(iii) Review the resultant critical and near critical paths to determine any impact of the occurrences encountered over the last month.

(4) Schedule Narrative

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

(5) Progress Meetings

(a) Review the updated schedule at each monthly progress meeting. Payments to the Contractor may be suspended if the progress schedule is not adequately updated to reflect actual conditions.

(b) Submit progress schedules to subcontractors to permit coordinating their progress schedules to the general construction work. Include 4 week look ahead schedules to allow subs to focus on critical upcoming work.

3. CRITICAL PATH METHOD (CPM)

a) This Section includes administrative and procedural requirements for the critical path method (CPM) of scheduling and reporting progress of the Work.

b) Refer to the General and Special Conditions and the Agreement for definitions and specific dates of Contract Time.

c) Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.

d) Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.

e) Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.

f) Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling, the construction project. Activities included in a construction schedule consume time and resources.

g) Critical activities are activities on the critical path.

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

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

- j) Float or Slack Time: The measure of leeway in activity performance. Accumulative float time is not for the exclusive use or benefit of the Owner or Contractor, but is a project resource available to both parties as needed to meet contract milestones and the completion date.
- k) Total float is herein defined as the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.
- l) Weather: Adverse weather that is normal for the area must be taken into account in the Contractor's Project Schedule. See 1.d.3, above.
- m) Force Majeure Event: Any event that delays the project but is beyond the control and/or contractual responsibility of either party.
- n) Schedule shall including the following, in addition to Contractor's work.
  - (1) Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
    - (a) Requirements for phased completion and milestone dates.
    - (b) Work by separate contractors.
    - (c) Work by the Owner.
    - (d) Coordination with existing construction.
    - (e) Limitations of continued occupancies.
    - (f) Uninterruptible services.
    - (g) Partial occupancy prior to Substantial Completion.
    - (h) Area Separations: Use Activity Codes to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.

#### 4. TIME EXTENSION REQUESTS

- a) Refer to General Conditions of the Contract for Construction, Article 4.7 Claims for Additional Time.
- b) Changes or Other Impacts to the Contractor's Work Plan
 

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

  - (1) An activity depicting the event(s) impacting the Contractors work plan shall be added to the CPM schedule, using the actual start date of the impact, along with actually required predecessors and successors.
  - (2) After the addition of the impact activity(ies), the Contractor will identify subsequent activities on the critical path, with finish to start relationships that can be realistically adjusted to overlap using good, standard construction practice.
    - (a) If the adjustments above result in the completion date being brought back within the contract time period, no adjustment will be made in the contract time.
    - (b) If the adjustments above still result in a completion date beyond the contract completion date, the delay shall be deemed excusable and the contract completion date shall be extended by the number of days indicated by the analysis.
    - (c) Contractor agrees to continue to utilize its best efforts to make up the time caused by the delays. However the Contractor is not expected to expend costs not contemplated in its contract, in making those efforts.
- c) Questions of compensability of any delays shall be held until the actual completion of the project. If the actual substantial completion date of the project based on excusable delays, excluding weather delays, exceeds the original contract completion date, AND there are no delays that are the responsibility of the contractor to consider, the delays days shall be considered compensable. The actual costs, if any, of the Contractor's time sensitive jobsite supervision and general conditions costs, shall be quantified and a change order issued for these costs.

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UNIVERSITY OF MISSOURI  
ROOF SYSTEM MANUFACTURERS CERTIFICATION  
(Revised 12/94)

TO: \_\_\_\_\_ Title \_\_\_\_\_  
Project No. \_\_\_\_\_  
Location \_\_\_\_\_

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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:

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

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ROOFING SYSTEM MANUFACTURER: \_\_\_\_\_

Authorized Signature: \_\_\_\_\_

Title: \_\_\_\_\_ Date \_\_\_\_\_

Telephone Number: ( ) \_\_\_\_\_

Fax Number: ( ) \_\_\_\_\_



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UNIVERSITY OF MISSOURI  
CONTRACTORS ROOFING/FLASHING/SHEET METAL GUARANTEE  
(Revised 12/94)

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 sheet metal 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: \_\_\_\_\_

**SHOP DRAWING AND SUBMITTAL LOG**

**Project: LABORATORY FOR INFECTIOUS DISEASE RESEARCH (LIDR) - Renovate West Animal Holding, Rms 144-149**

**Project Number: CP220692**

**Contractor:**

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To	
										Owner	File
024119	Protection Measures, Schedule of Demolition, Predemolition Photographs or Video										
033000	Product Data, Design Mixtures, Shop drawings, Construction Joint layout										
042613	Product data, samples for selection, material certificates, mix designs.										
047200	Product data, samples, qualification data, test reports										
055000	Shop Drawing										
054000	Product Data, Shop Drawings, Delegated Design, Welding Certificates, Reports, Qualifications										
061000	Product Data, Reports										
061600	Product Data, Reports										
072100	Product Data, Reports										
072500	Product Data, Reports										
074116	Product Data, Qualifications, Certificates, Reports, Shop Drawings, Samples, Warranties										
074213	Product Data, Qualifications, Certificates, Reports, Shop Drawings, Samples, Warranties										
076200	Product Data, Qualifications, Certificates, Reports, Shop Drawings, Samples, Warranties										
078413	Product Data, Product Schedule, Qualifications, Certificates, Reports										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
081113	Product Data, Reports, Shop Drawings, Schedule										
087100	Product Data, Hardware Schedule, Qualifications, Reports										
088000	Product Data, Qualifications, Certificates, Reports, Adhesion Test Report, Warranties										
089119	Product Data, Shop Drawings, Samples, Reports										
092216	Product Data										
092900	Product Data										
096513	Product Data, Samples										
096733	System Data, Qualifications, Reports, Samples, Packing Slip, Warranties										
099600	Product Data, Samples, Product List										
102600	Shop Drawings, Samples, Warranties										
102800	Product Data, Product Schedule, Warranties										
1112504 3	Product Data, Shop Drawings, Qualifications, Warranty										
1321001 6150	Product Data, Shop Drawings, Project Schedule, Qualifications, Certificates, Reports, sample warranty										
211313	Product Data, Qualifications, Certificates, Reports, Shop Drawings, Delegated Design Submittal, Coordination Drawings, Approved Sprinkler Drawings										
220500	Product Data, Pipe Pressure Test Logs, Coordination Drawings, Welding Certificates										
220519	Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
220529	Product Data, Shop Drawings										
220553	Shop Drawings, Equipment Label Schedule, Valve Numbering & Schedule,										
220716	Product Data, Shop Drawings										
220719	Product Data, Shop Drawings										
221000	Product Data, Shop Drawings, Operation & Maintenance Data, Pipe Pressure Test Logs										
221119	Product Data, Shop Drawings, Operation & Maintenance Data,										
224000	Product Data, Shop Drawings, Wiring Diagrams, Operation & Maintenance Data										
226113	Product Data, Shop Drawings, Pipe Pressure Test Logs										
226700	Operation & Maintenance Data, Shop Drawings, Pipe Pressure Test Logs, Operation & Maintenance Data										
230500	Coordination drawings for access panel and door locations, Welding Certificates, Pipe Pressure Test Logs,										
230519	Product Data, Shop Drawings, Operation & Maintenance Data										
230529	Product Data, Show Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
230553	Shop Drawings, Equipment Label Schedule, Valve Numbering & Schedule,										
230713	Product Data, Shop Drawings, Installer Qualifications										
230716	Product Data, Shop Drawings,										
230719	Product Data, Shop Drawings										
230900	Product Data, Shop Drawings, Schematic Flow Diagrams, Wiring Diagrams, Operation & Maintenance Data										
230993	Written Sequence of Operation										
232113	Product Data, Shop Drawings, Field Quality-control Reports, Operation & Maintenance Data, Water Analysis										
232116	Product Data, Shop Drawings, Wiring Diagrams, Operation & Maintenance Data,										
232213	Product Data, Shop Drawings, Field Quality-control Reports, Operation & Maintenance Data										
232214	Product Data, Shop Drawings, Wiring Diagrams, Operation & Maintenance Data,										
233113	Product Data, Shop Drawings, Test Reports, Manufacturer's Instructions, Field Reports, Operation Data, Maintenance Data										
233650	Product Data, Shop Drawings										

Section	Description	Contractor	Date Rec'd	#	Date Sent to Cons.	Date Ret'd	Remarks	Date ret'd	Cont'r	Copies To Owner	File
233650	Product Data, Shop Drawings										
238216	Product Data, Shop Drawings, Operation & Maintenance Data,										
260500	Test Reports, Shop Drawings, Operation & Maintenance Data										
260501	Product Data, Shop Drawings										
260519	Product Data, Shop Drawings										
260526	Product Data										
260533	Product Data										
262726	Product Data										
262913	Product Data, Shop Drawings										
264100	Product Data, Shop Drawings										
265100	Product Data										
283111	Product Data, Shop Drawings, Qualification Data - Installer										
323113	Delegated Design, Product Data, Samples, Certificates, Reports, Warranty, Qualifications										
323119	Delegated Design, Product Data, Samples, Certificates, Reports, Warranty, Qualifications										



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**OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG**

**Project: LABORATORY FOR INFECTIOUS DISEASE RESEARCH (LIDR) - Renovate West Animal Holding, Rms 144-149**

**Project Number: CP220691**

**Contractor:**

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
074116	Standing-Seam Metal Roof Panels				X			
074213	Formed Metal Panels				X			
076200	Sheet Metal Flashing and Trim				X			
087100	Door Hardware				X			
102800	Toilet & Bath Accessories				X			
111243	Vehicle Barrier Systems		X	X	X	X		X
123553	Metal Laboratory Casework		X	X	X			X
116059	Laboratory Equipment	X			X	X		X
210500	Product Data	X			X	X		X
211200	Product Data	X			X	X		X
211313	Product Data	X		X	X	X	X	
211313	Approved Sprinkler Piping Drawing	X						X
211313	Field Test Reports and Certificates	X			X			X
211313	Field Quality Control Test Reports	X						X
211313	Operation and Maintenance	X						
220500	Warranties	X						
220500	As-Built Drawings	X						
220500	Pipe Pressure Test Logs				X	X		X
220529	Plumbing Hangers and Supports	X			X	X		X
220553	Plumbing Identification	X		X				
220553	Equipment Label Schedule	X		X				
220553	Valve Numbering Scheme	X		X				
220716	Plumbing Equipment Insulation	X		X				
220719	Plumbing Piping Insulation	X		X	X	X		X
221000	Plumbing Piping	X			X	X		X
221119	Plumbing Specialties	X						

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Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
224000	Plumbing Fixtures	X	X	X	X	X		X
226113	Product Data	X			X	X		X
226113	Field Quality Control Reports	X			X			X
226700	Product Data	X			X	X		X
226700	Field Quality Control Reports	X			X			X
230500	Warranties	X						
230500	As-Built Drawings							
230500	Pipe Pressure Test Logs							
230529	HVAC Hanger and Supports	X		X	X	X		
230553	HVAC Identification	X						
230713	Ductwork Insulation	X		X				
230719	HVAC Piping Insulation	X		X				
230900	Digital Controls Equipment	X	X	X	X	X		X
232113	Hydronic Piping	X			X	X		X
232116	Hydronic Specialties	X	X	X	X	X		X
233300	Air Duct Accessories	X		X	X	X		X
233650	Laboratory Airflow Control System	X		X	X	X		X
233700	Air Outlets & Inlets	X		X		X		
238216	Duct-Mounted Coils	X		X	X			
260500	Electrical General Provisions				X			X
260519	Conductors	X						
260526	Grounding System	X			X			
260533	Raceways	X			X			
262726	Wiring Devices	X		X	X			
262913	Motor Controllers	X	X	X	X			X
262923	Variable Frequency Drives	X	X	X	X			X
265100	Lighting	X		X	X	X		
283111	Digital Addressable Fire Alarm System	X	X	X	X	X		X
323119	Steel Security Fence System		X		X			

**CLOSEOUT LOG**

**Project: LABORATORY FOR INFECTIOUS DISEASE RESEARCH (LIDR) - Renovate West Animal Holding, Rms 144-149**

**Project Number: CP220691**

**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					
068315	ACRYLOYL ENGINEERED POLYMER WALL AND CEILING PANELS Warranty					
074116	STANDING-SEAM METAL ROOF PANELS Maintenance Data Warranties					
074213	FORMED METAL PANELS Maintenance Data Warranties					
076200	SHEET METAL FLASHING AND TRIM Maintenance Data					
079200	JOINT SEALANTS Mfgr Warranty Installer Warranty					
087100	DOOR HARDWARE Warranty Keys					
096733	TROWELED APPLIED RESINOUS FLOORING Warranty					

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
099123	PAINTING Extra Materials					
102600	WALL PROTECTION Warranty					
102800	TOILET ACCESSORIES Warranties					
111243	VEHICLE BARRIER SYSTEMS As-Builts Warranty Operation & Maintenance Data					
116050	LABORATORY EQUIPMENT Operation & Maintenance Data Warranty Test Reports					
211313	WET-PIPE SPRINKLER SYSTEMS Warranties, as-built drawings, piping, pressure test logs, closeout walk through documentation, owner training documentation					
220500	BASIC PLUMGING REQUIREMENTS Warranties, as-built drawings, piping pressure test logs, closeout walk through documentation, owner training documentation					
221000	PLUMING PIPING Plumbing Piping Hydrostatic pressure test report, Provide two (2) repacking kits for each size valve					
221119	PLUMBING SPECIALTIES Project Record Documents					
224000	PLUMBING FIXTURES Project Record Documents					
226113	SPECIALTY GAS PIPING Project Record Documents					
230500	BASIC HVAC REQUIREMENTS Warranties, as-built drawings, piping pressure test logs, closeout walk through documentation, owner training documentation					
230519	HVAC METERS AND GAUGES Project record documents					

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
230900	DIGITAL CONTROL EQUIPMENT Project Record Documents					
230901	INSTRUMENTS AND CONTROL ELEMENTS Project Record Documents					
232113	HYDRONIC PIPING Plumbing Piping Hydrostatic pressure test report, Provide two (2) repacking kits for each size valve					
232213	STEAM AND CONDENSATE PIPING Plumbing Piping Hydrostatic pressure test report, Provide two (2) repacking kits for each size valve					
233113	DUCTWORK Owner approval of ductwork cleaning, Damper re-setting demonstration to Owner					
233300	DUCTWORK ACCESSORIES Project Record Documents					
233650	LABORATORY AIRFLOW CONTROLS Project Record Documents Warranty					
233700	AIR OUTLETS AND INLETS Project Record Documents Warranty					
238216	AIR COILS Project Record Documents Warranty					
260500	ELECTRICAL GENERAL PROVISIONS Electrical Test Reports and Motor Test Reports, Record Documents					
260501	BASIC MATERIALS AND METHODS Extra materials Record Documents					
260519	CONDUCTORS Record Documents					
260533	RACEWAYS Record Documents					
262726	WIRING DEVICES Record Documents					
262913	MOTOR CONTROLLERS Record Documents					

Section	Description	Contractor/Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
264100	LIGHTNING PROTECTION SYSTEMS Record Documents					
265100	LIGHTING Record Documents					
283111	ADDRESSABLE FIRE ALARM SYSTEM Record Documents, Extra Materials					
323113	CHAIN LINK FENCES AND GATES Warranty					
323119	STEEL SECURITY FENCE SYSTEM Warranty					

# CP220692 LIDR Renovate Rm 144 to 149 Quality Assurance Check List

	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Divisio	Name	Firm				
<i>1</i>						
<b>Building System Quality Assurance</b>						
QA Agent - Conduct pre-installation meetings per specifications.					Meeting Minutes	<input checked="" type="checkbox"/>
<i>19113</i>						
<b>General Commissioning Requirements</b>						
Perform Functional Performance testing section of specifications					Test Report	<input checked="" type="checkbox"/>
<i>24119</i>						
<b>Selective Demolition</b>						
Hold Pre-installation meetings as specified					Meeting Minutes	<input checked="" type="checkbox"/>
Maintain dust control using temp enclosures and wet mopping floors to eliminate trackable dirt						<input type="checkbox"/>
<i>33000</i>						
<b>Cast-In-Place Concrete</b>						
Provide a Copy Of Field Cured Concrete Cylinder Test Report to Owner's Rep Prior to Stripping Any Load Bearing Formwork					Test Report From Independent Testing Lab	<input type="checkbox"/>
Sampling and testing shall be done in accordance with contract documents						<input type="checkbox"/>
Submit concrete mix designs prepared by a qualified testing laboratory for approval prior to placement.					mix design reports	<input type="checkbox"/>
<i>42113</i>						
<b>Brick Masonry</b>						
Build Mockup as specified					Inspection Report	<input checked="" type="checkbox"/>



Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Divisio	Name	Firm			
Help Third party perform Field Quality Control section of specifications				Thirt Party Test Report	<input checked="" type="checkbox"/>
<b>54000</b>					
<b>Cold-Formed Metal Framing</b>					
Build Mockup as specified				Inspection Report	<input checked="" type="checkbox"/>
Help third party Perform Field Quality Control section of specifications				Third Party Test Report	<input checked="" type="checkbox"/>
Hold Pre-installation meetings as specified				Meeting Minutes	<input checked="" type="checkbox"/>
Provide welder qualification report for each welder on site				Welder Qualifications	<input checked="" type="checkbox"/>
<b>68315</b>					
<b>Acryloyl Engineered Polymer Wall and Ceiling Panels</b>					
Perform Commissioning section of specifications				Commissioning Report	<input checked="" type="checkbox"/>
<b>74116</b>					
<b>Standing-Seam Metal Roof Panels</b>					
Hold Pre-installation meetings as specified				Meeting Minutes	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications				Test Report	<input checked="" type="checkbox"/>
<b>74213</b>					
<b>Formed Metal Panels</b>					
Perform test per field quality control section of specifications				test report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Divisio	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>79200</b>						
<b>Joint Sealants</b>						
Build mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
Perform Adhesion Tests per specifications					field report	<input checked="" type="checkbox"/>
<b>81113</b>						
<b>Hollow Metal Doors and Frames</b>						
Check Fire Tags on Doors and Frames					Inspection Report	<input checked="" type="checkbox"/>
<b>87100</b>						
<b>Door Hardware</b>						
Perform Maintenance Service section of specifications					Transmittal	<input checked="" type="checkbox"/>
<b>92900</b>						
<b>Gypsum Board</b>						
Ensure all fire and smoke barriers are stenciled as such and their hour rating					Inspection Report	<input checked="" type="checkbox"/>
<b>96733</b>						
<b>Trowel-Applied Resinous Flooring</b>						
Build Mockups as specified					Inspection Report	<input checked="" type="checkbox"/>
<b>99123</b>						
<b>Interior Painting</b>						
Furnish Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>

Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
Commissioning Items by CSI Divisio	Name	Firm			
<b>99600</b>					
<b>High-Performance Coatings</b>					
Build Mockup as specified				Inspection Report	<input checked="" type="checkbox"/>
<b>111243</b>					
<b>Vehicle Barrier Systems</b>					
Perform Field Testing and Commissioning section of specifications				Test Report	<input checked="" type="checkbox"/>
Perform Field Training section of specifications				Sign In sheet	<input checked="" type="checkbox"/>
Perform maintenance service section of specifications				Maintenance Report	<input checked="" type="checkbox"/>
<b>116150</b>					
<b>Laboratory Equipment</b>					
Perform Demonstration section of specifications				Sign in Sheet	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications				Test Report	<input checked="" type="checkbox"/>
<b>132100</b>					
<b>Controlled Environmental Rooms</b>					
Factory Rep Shall Provide Final Adjustment, Startup and Complete Operational Check. Verify Correct Operation Within All Specified Ranges For a Continuous 24 Hour Period.				certification, chart recordings	<input checked="" type="checkbox"/>
Perform Demonstration section of specifications				Sign In Sheet	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications				Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Divisio	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>210500</b>						
<b>Basic Fire Suppression Requirements</b>						
Perform Start-Up section of specifications					Startup Report	<input checked="" type="checkbox"/>
<b>211313</b>						
<b>Fire Protection System</b>						
Flush, test and inspect stand piping per Field Quality Control section of specifications					test results report, NFPA 13 Certification	<input checked="" type="checkbox"/>
Furnish Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
Provide system operation & maintenance training per Demonstration section of specs.					Sign in sheet	<input checked="" type="checkbox"/>
Provide welder qualification report for each welder on site					Welder Certificates	<input checked="" type="checkbox"/>
<b>220500</b>						
<b>Basic Plumbing Requirements</b>						
Clean and flush all piping systems and associated strainers						<input type="checkbox"/>
Hold MEP pre-installation meeting(s).					Meeting Minutes and Sign-up Sheet	<input checked="" type="checkbox"/>
Perform Closeout and Operation Instructions section of specifications					Sign in sheet	<input checked="" type="checkbox"/>
Perform Piping Systems Pressure Testing section of specifications					Test Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Divisio		Verified by:	Date compl	Coord Initial	Documentation Required	Owner Witness Required
		Name	Firm			
<b>220553</b>						
<b>Plumbing Identification</b>						
Install valve tags on valves and control devices per specifications					Valve Schedule framed/posted	<input type="checkbox"/>
<b>220719</b>						
<b>Plumbing Piping Insulation</b>						
Verify all valve stems are extended and accessible						<input type="checkbox"/>
<b>221000</b>						
<b>Plumbing Piping</b>						
Perform Disinfection of Water Piping Systems Section of specs.					Flush Report, Bacteria Test Report	<input checked="" type="checkbox"/>
Perform Plumbing Piping Pressure Testing Section of specs. No Air testing of PVC nor PEX piping					Test Report	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>221119</b>						
<b>Plumbing Specialties</b>						
Perform Testing Section of Specifications					Test Report	<input checked="" type="checkbox"/>
<b>226113</b>						
<b>Compressed Air, Vacuum, and Specialty Gas Systems</b>						
Perform Field Quality Control section of specifications					written test reports	<input checked="" type="checkbox"/>

Commissioning Items by CSI Divisio	Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
	Name	Firm				
<b>230500</b>						
<b>Basic HVAC Requirements</b>						
Hold MEP pre-installation meeting(s).					Meeting Minutes	<input checked="" type="checkbox"/>
Install equipment to provide maximum possible headroom if mounting heights are not indicated.						<input type="checkbox"/>
Perform Piping Systems Pressure Testing section of specifications					Test Report	<input checked="" type="checkbox"/>
Pull Permits, including pressure vessel permits, as required by State and Specs					Permits	<input checked="" type="checkbox"/>
<b>230553</b>						
<b>HVAC Identification</b>						
Install pipe markers per specifications. Install valve tags and valve schedule as specified. Hang schedule where maintenance personnel directs					Valve Schedule	<input checked="" type="checkbox"/>
<b>230713</b>						
<b>Ductwork Insulation</b>						
Ensure mechanical fasteners are installed as specifed					Inspection Report	<input checked="" type="checkbox"/>
<b>230719</b>						
<b>HVAC Piping Insulation</b>						
Verify all piping unions are accessible for maintenance						<input type="checkbox"/>
<b>230900</b>						
<b>Digital Control Equipment</b>						
Check and record amp draw on supply transformers of I/O panels					Test Report	<input checked="" type="checkbox"/>

Verified by:						
Commissioning Items by CSI Divisio	Name	Firm	Date compl	Coord Initial	Documentation Required	Owner Witness Required
Ensure shipping material has been removed from thermostats and other control devices						<input type="checkbox"/>
Install and assist at start up as specified						<input type="checkbox"/>
Post laminated control diagram in mechanical room						<input type="checkbox"/>
Verify all field devices provided by contractor are terminated						<input type="checkbox"/>
Verify method of labeling used for identification has been defined to the Owners Representative						<input type="checkbox"/>
<b>232113</b>						
<b>Hydronic Piping</b>						
Pressure test piping per System Flushing, Filling, Pressure Testing and Cleaning section of specifications					test report	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
Remove and clean all strainers after flushing system					Flush Report	<input checked="" type="checkbox"/>
<b>232213</b>						
<b>Steam and Condensate Piping</b>						
Verify restraints and guides are properly installed						<input type="checkbox"/>
<b>232214</b>						
<b>Steam and Condensated Specialties</b>						
Perform Startup Service section of specifications					Startup Report	<input checked="" type="checkbox"/>

Commissioning Items by CSI Divisio		Verified by:	Date compl	Coord Initial	Documentation Required	Owner Witness Required
		Name	Firm			
<b>233113</b>						
<b>Ductwork</b>						
test for duct leakage per "Pressure Testing" section of spec. Ducts shall meet leakage requirement prior to testing and balancing. Leakage Class of 4 if not otherwise specified.					test report	<input checked="" type="checkbox"/>
<b>233300</b>						
<b>Ductwork Accessories</b>						
Demonstrate Proper Operation of All Fire Dampers per NFPA-90A.					test report	<input checked="" type="checkbox"/>
Perform Field Quality Control section of specifications.					Test Report	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>
<b>233650</b>						
<b>Laboratory Airflow Control System</b>						
Perform System Start-up and Training section of specifications					Startup Report and Sign in sheet	<input checked="" type="checkbox"/>
<b>234000</b>						
<b>Containment Filter Housing Assemblies</b>						
Perform Factory Acceptance Tests section of specifications.					Test Report	<input checked="" type="checkbox"/>
Perform Factory Quality Assurance section of specifications.					Test Report	<input checked="" type="checkbox"/>
Provide Extra Material as specified					Transmittal	<input checked="" type="checkbox"/>



Commissioning Items by CSI Divisio		Verified by:		Date compl	Coord Initial	Documentation Required	Owner Witness Required
		Name	Firm				
<b>260519</b>							
<b>Conductors</b>							
Perform megohm/high pot tests as specified						test report	<input checked="" type="checkbox"/>
<b>260526</b>							
<b>Grounding System</b>							
Perform resistance test						test report	<input checked="" type="checkbox"/>
<b>262726</b>							
<b>Wiring Devices</b>							
Check all receptacles for proper operation							<input type="checkbox"/>
Check all switches for proper operation						document on field copy of drawings	<input type="checkbox"/>
<b>264100</b>							
<b>Lightning Protection System</b>							
Provide periodic and final inspections as required by LPI-177 in order to obtain UL Master Label						field report, certification, and Master Label	<input checked="" type="checkbox"/>
<b>265100</b>							
<b>Lighting</b>							
Illuminate emergency lights and Exit lights for 90 minutes on battery power, or show they are attached to generator.						Test Report	<input checked="" type="checkbox"/>
<b>323113</b>							
<b>Chain Link Fences and Gates</b>							
Perform Demonstration section of specifications						Sign In Sheet	<input checked="" type="checkbox"/>

Please see following website for suggested commissioning forms:

<https://operations.missouri.edu/facilities/commissioning-forms>

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# Construction Management Checklist for Energizing Utilities

(Contractor to initial each item upon completion and provide completed form to the Owner's Representative prior to energizing utility)

Page 1 of 2 (Updated 10/23)

## Water – turned on to the first valve past Energy Management's last valve.

- Review all piping and equipment being turned on for proper installation and completed testing.
- Insulation installed (preferred but not required)
- Meter & sensors properly installed, working, remote read operational, and in readable location.
- Contractor has swabbed out with chlorine all piping from the backflow preventer to the source while installing.
- All bacteriological tests have been completed and passed.
- Backflow preventer installed and tested. (will need water pressure to test)
- Pressure test completed for piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off.
- Permitting/Inspection authority has signed off and provided documentation of approval to energize.

## Steam – turned on to the first valve past Energy Management's last valve.

- Review all piping, equipment, valves, reducing stations, relief valves, etc. for proper installation and complete testing.
- Piping protected from the weather/water.
- Insulation must be installed.
- All hangers and bolts have been installed.
- Meter & sensors installed, working, remote read operational and in readable location.
- All needed traps are installed and able to be tested as they are turned on.
- Condensate system is installed and operating including the pumping system.
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off.
- Permitting/Inspection authority has signed off and provided documentation of approval to energize.

## Condensate – turned on to the first valve past Energy Management's last valve.

- Review all piping and equipment being turned on for proper installation and completed testing.
- Piping protected from the weather/water.
- Insulation must be installed.
- Pressure test completed in piping being turned on.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off.
- Permitting/Inspection authority has signed off and provided documentation of approval to energize.

## Electric – turned on to the first breaker past 13.8kV transformer.

- Review all wiring and equipment being turned on for proper installation and completed testing.
- Coordination & Arc Flash studies complete with owner approvals and appropriate labels installed on equipment being energized.
- GFCI set and tested.
- Breakers & remote operators set and tested per approved studies.
- All needed permanent grounds are installed.
- Meter installed, working and in readable location.
- Main switchgear protected from the weather/water.
- Contractor has method to communicate "Services On" to other contractor & Owner's personnel.
- Consultant has signed off.
- Permitting/Inspection authority has signed off and provided documentation of approval to energize.

**Chilled Water – turned on to the first valve inside of building.**

- Review all piping and equipment being turned on for proper installation and completed testing.
- Pressure test completed in piping being turned on.
- Insulation must be installed.
- Meter installed, working and connected to remote read.
- Building pump and automatic isolation/control valve must be installed and under control.
- If chillers are installed, automatic loop pump isolation must be installed.
- Control valves must be installed and automatically controlled on all loads.
- Contractor has method to communicate "Services On" to other contractor personnel and Owner's personnel.
- Consultant has signed off.
- Permitting/Inspection authority has signed off and provided documentation of approval to energize.

**\*Fill out all form fields before signing!**

**Name** \_\_\_\_\_ **Organization** \_\_\_\_\_ **Title** \_\_\_\_\_ **Signature** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ University of Missouri Commissioning Authority



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## SECTION 1.F

### INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consist of following sheets dated **December 18, 2023**.

Sheet 1 of 36: G0.00 Title Sheet and Drawing Index  
Sheet 2 of 36: G1.00 Code and Containment Plans  
Sheet 3 of 36: G1.01 Phasing Plans and Dust Control  
Sheet 4 of 36: G1.20 Accessibility Details  
Sheet 5 of 36: A0.00 Wall Type Schedule & Details  
Sheet 6 of 36: A0.01 Site Demolition Plan  
Sheet 7 of 36: A0.10 First Floor and First Floor Reflected Ceiling Demolition Plans  
Sheet 8 of 36: A0.11 Penthouse and Roof Demolition Plans  
Sheet 9 of 36: A1.01 Site Plan  
Sheet 10 of 36: A1.10 First Floor and First Floor Reflected Ceiling Plans  
Sheet 11 of 36: A1.11 Penthouse and Roof Plans  
Sheet 12 of 36: A2.10 Exterior Elevations  
Sheet 13 of 36: A3.10 Wall Sections  
Sheet 14 of 36: A4.10 Details  
Sheet 15 of 36: LF0.10 Laboratory Schedules, Sections, and Details  
Sheet 16 of 36: LF1.00 Enlarged Plans & Elevations  
Sheet 17 of 36: M0.00 Mechanical Abbreviations, Symbols & Notes  
Sheet 18 of 36: M1.01 First Floor HVAC Plans  
Sheet 19 of 36: M1.02 First Floor Pressurization Plans  
Sheet 20 of 36: M2.01 First Floor Piping Plans  
Sheet 21 of 36: M2.02 Penthouse Piping Plans  
Sheet 22 of 36: M3.01 Mechanical Details  
Sheet 23 of 36: M3.02 Air System Schematic  
Sheet 24 of 36: M4.01 Mechanical Controls  
Sheet 25 of 36: M5.01 Mechanical Schedules  
Sheet 26 of 36: FS1.01 Fire Suppression Plan  
Sheet 27 of 36: E0.00 Electrical Abbreviations, Symbols Legend & General Notes  
Sheet 28 of 36: E0.01 Electrical Site Plan & Basement Orientation Plan  
Sheet 29 of 36: E0.11 First Floor Electrical Demolition Plan  
Sheet 30 of 36: E0.12 Penthouse Electrical Demolition Plan  
Sheet 31 of 36: E1.01 First Floor Lighting Plan  
Sheet 32 of 36: E2.01 First Floor Power & Auxiliary Systems Plan  
Sheet 33 of 36: E2.02 Penthouse Power & Auxiliary Systems Plan  
Sheet 34 of 36: E3.01 Electrical Schedules  
Sheet 35 of 36: E4.01 Electrical Details  
Sheet 36 of 36: E4.02 Electrical Details

END OF SECTION



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SECTION 1.G

PREVAILING WAGE RATES

**Missouri**  
**Division of Labor Standards**  
WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

**Annual Wage Order No. 30**

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 10, 2023

Last Date Objections May Be Filed: April 10, 2023

Prepared by Missouri Department of Labor and Industrial Relations

Building Construction Rates for  
BOONE County

Section

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$58.05
Boilermaker	\$73.87
Bricklayer	\$53.18
Carpenter	\$49.00
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$47.52
Plasterer	
Communications Technician	\$57.48
Electrician (Inside Wireman)	\$58.51
Electrician Outside Lineman	\$76.79
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$31.16*
Glazier	\$65.21
Ironworker	\$65.92
Laborer	\$42.86
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$31.16*
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$64.73
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$40.26
Plumber	\$69.73
Pipe Fitter	
Roofer	\$53.14
Sheet Metal Worker	\$56.02
Sprinkler Fitter	\$61.21
Truck Driver	\$31.16*
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.

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$53.37
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$76.79
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$46.32
General Laborer	
Skilled Laborer	
<b>Operating Engineer</b>	<b>\$65.15</b>
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$31.16*
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 following Additive Alternate proposal(s) as Owner may elect:

1. Additive Alternate No. 1: **New vehicle barrier gate.**

Base Bid: No new work.

Add Alternate: Remove and dispose of existing vehicle barrier gate and operating housing. Provide installation of new barrier gate and operating housing. Operating initiation from existing access control pedestal. Provide temporary concrete barriers to secure during construction.

2. Additive Alternate No. 2: **Additional Phase 2 epoxy floor areas.**

Base Bid: No new work.

Add Alternate: Prepare existing floors and provide epoxy floor system to rooms indicated to be a part of Phase 2A and 2B on sheet G1.01.

3. Additive Alternate No. 3: **Additional Phase 3 epoxy floor area.**

Base Bid: Epoxy work as indicated for rooms indicated to be a part of Phase 1A, 2A, and 2B on sheet G1.01.

Add Alternate: Prepare existing floors and provide epoxy floor system to rooms indicated to be a part of Phase 3 on sheet G1.01.

4. Additive Alternate No. 4: **New roof over low-slope roof area.**

Base Bid: No new work.

Add Alternate: Prepare existing low-slope roof area as indicated and provide new sloped standing seam metal roof over area as indicated and site work as required to connect drainage to the storm system.

5. Additive Alternate No. 5: **Motorized vehicle gate in security fence.**

Base Bid: No new work to existing manual vehicle gates within the security fence.

Add Alternate: Remove existing manual vehicle gate in security fence as indicated, and provide motorized swing gate. Provide all required site work and relevant electrical and security electronics work as indicated.

END OF SECTION

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Contract Documents

MU Project #: CP220692  
TCEP Project #: 624-216-22

## **SECTION 01 73 29 - CUTTING AND PATCHING**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching.

#### 1.3 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce the load-carrying capacity or load-deflection ratio.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing the capacity to perform as intended.
- C. Visual Requirements: Do not cut and patch exposed work in a manner that results in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually satisfactory manner as determined by Architect.

### **PART 2 PRODUCTS**

#### 2.1 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available, use materials that match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance will equal or surpass that of existing materials.

### **PART 3 EXECUTION**

#### 3.1 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
  - 1. Protection: Protect existing construction during cutting and patching.



Contract Documents

MU Project #: CP220692  
TCEP Project #: 624-216-22

### 3.2 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction.
- C. Patching: Patch with durable seams that are invisible.
  - 1. Restore exposed finishes in a manner that will eliminate evidence of patching and refinishing.
  - 2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials as required to achieve uniform color and appearance.
    - a. Where patching occurs in a smooth paint surface, extend final paint coat over entire unbroken surface after the patched area has received primer and second coat.
  - 3. Patch, repair or rehabbing existing ceiling as necessary to provide an even plane surface of uniform appearance.

### 3.3 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching are performed.

END OF SECTION 01 73 29

Contract Documents

MU Project #: CP220692  
TCEP Project #: 624-216-22

## **SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT TRACKING**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 01 General Requirements, apply to the work of this Section.

#### **1.2 SUMMARY**

- A. This Section specifies requirements for the Contractor's implementation of waste management controls and systems for the duration of the Work.

The intent of this Section is to develop and implement a Construction Waste Management Plan (CWMP) in order to quantify material diverted from Solid Waste Disposal Facility or incineration. Quantities must be reported by weight and consistent in units reported and calculation method throughout.

Diversion Methods and Materials Eligible for Reporting:

- 1. Appropriate materials suitably placed in a Clean Fill Site may be reported
- 2. Appropriate materials diverted for use as Wood Derived Fuel (WDF) may be reported

Diversion Methods and Materials Ineligible for Reporting:

- 3. Material disposal by incineration
- 4. Excavated soil and land-clearing debris
- 5. Material for use as Alternative Daily Cover (ADC)
- 6. Hazardous waste; should be disposed of according to relevant regulations

- B. Contractor may subcontract work of this Section to a sub-contractor specializing in recycling and salvaging of construction waste.

#### **1.3 DEFINITIONS**

- A. **ALTERNATIVE DAILY COVER (ADC):** Material (other than earthen material) that is placed on the surface of the active face of a municipal solid waste landfill at the end of each operating day.
- B. **AVERAGE RECYCLING RATE:** The weighted average for the diversion of materials by the commingled (mixed-stream) recycling facility over time.
- C. **CLEAN FILL SITE:** Re-grading fill site for land reclamation or other beneficial use. Typically requiring permits, regular site maintenance and hours of operation. With material consisting of

Contract Documents

MU Project #: CP220692  
TCEP Project #: 624-216-22

demolition debris and construction waste from buildings, roads and highway pavement, and other structures. Commonly comprised of brick, ceramics, concrete, and asphalt paving fragments that are virtually inert and pose neither a pollution threat to ground or surface waters nor a fire hazard. May contain minimal amounts of wood, metal and inert solids.

- D. **COMMINGLED WASTE:** Waste streams that are combined on the project site and hauled away for sorting into recyclable streams. Also known as mixed or single-stream recycling.
- E. **DEMOLITION AND CONSTRUCTION DEBRIS:** Debris, waste and surplus materials, including recyclables, generated as a result of the Contractor's onsite activities while executing the requirements of the contract. Also, commonly includes materials from renovation, demolition, or deconstruction activities.
- F. **RECYCLE:** Recovery of materials, otherwise diverted from the solid waste stream for remanufacturing.
- G. **SALVAGE:** Recovery of useful items repurposing without the need for remanufacturing or reducing to raw materials due to their intrinsic value.
- H. **SOLID WASTE DISPOSAL FACILITY:** A managed landfill, regulated at the Federal, State, and/or Local level.

1.4 INTENT

- A. The Owner and Architect have established that this Project shall track the amount of Demolition and Construction debris. The Contractor shall develop and employ processes that ensure that the amount of demolition and construction debris actually generated during the execution of this project due to error, poor planning, breakage, mishandling, contamination or other factors is minimized.
- B. Of the construction and demolition debris generated, as much as is economically feasible shall be reused, salvaged, or recycled. Disposal of construction and demolition debris in solid waste disposal facilities shall be minimized to the greatest extent practical.
- C. The Contractor shall develop, for the Architect's review, a Construction Waste Management Plan (CWMP) for this Project.
- D. Contractor shall be responsible for ensuring that construction and demolition debris, not otherwise salvaged or recycled will be disposed of at appropriately licensed solid waste disposal facilities.

1.5 SUBMITTALS

Contract Documents

MU Project #: CP220692  
TCEP Project #: 624-216-22

1.6 Construction Waste Management Plan (CWMP): Within 21 calendar days after receipt of Notice to Proceed, the Contractor shall provide a plan for review and approval by architect and owner. The Construction Waste Management Plan shall be uploaded in the format provided at the end of this section (available for download here: [http://www.cf.missouri.edu/cf/pdc/contractor\\_information](http://www.cf.missouri.edu/cf/pdc/contractor_information)) and shall at a minimum contain the following:

1. Analysis of the proposed jobsite waste to be generated, including types and estimated quantities.
2. Solid Waste Disposal Facility Options: The name of the facilities landfills where construction and demolition debris not otherwise salvaged or recycled will be disposed of, the applicable landfill tipping disposal fees, and the projected cost of such disposal.
3. Solid Waste Disposal Facility Certification: Contractor's statement of verification that facilities proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.
4. Recycling Facility Options: Facilities providing commingled or mixed-stream recycling must provide diversion rates either specific to the project, or an average diversion rate that is regulated by the local or state authority. The average recycling rate for the facility must exclude ADC. Measurements must be based on weight (not volume), using scales. Reporting increments shall be no more than annually, and must use consistent time increments throughout calculations.
5. Alternatives: A list of each material proposed to be salvaged or recycled during the course of the Project and the planned reuse strategy or diversion destination of each. Include the following and any additional items proposed:
  - a. Cardboard
  - b. Clean wood
  - c. Beverage containers
  - d. Concrete
  - e. Slurry wall materials
  - f. Bricks and masonry
  - g. Asphalt
  - h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze
  - i. Mechanical and electrical equipment
  - j. Building components which can be removed relatively intact from existing construction
  - k. Packaging materials
  - l. Glass
  - m. Scraps from new gypsum wall board
  - n. Carpet and pad
  - o. Acoustical ceiling panels
  - p. Plastics

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6. Meetings: A description of the regular meetings to be held to ensure proper execution of the construction waste management plan.
  7. Debris Handling Procedures: A description of the means by which any construction waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
  8. Transportation: A description of the means of transportation of the debris (whether debris will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).
- B. Waste Management Progress Report: Concurrent with each Application for Payment, submit a written Waste Management Progress Report in the same format as required for Final Report. Submission of this report shall be a pre-requisite to the Owner's approval of the Contractor's application for Payment. Provide statement indicating original estimated total diversion rate, diversion to date, and expected final diversion rate. Include narrative regarding discrepancies or activity since the previous report.
- C. Waste Management Final Report: Within five (5) calendar days of Substantial Completion, submit a written Construction Waste Management Final Report summarizing the types and quantities of materials recycled, salvaged and disposed of under the Construction Waste Management Plan. This report shall be in the same format as the monthly reports. Include the name and location of disposal facilities. Quantities must be reported by weight and consistent in units reported and calculation method throughout. Include the following:
1. Material category
  2. Generation point
  3. Total quantity of waste by category
  4. Total quantity of waste reused
  5. Total quantity of waste salvaged, both estimated and actual
  6. Total quantity of waste recycled, both estimated and actual
  7. Total quantity of waste diverted (salvaged and recycled)
  8. Total quantity of waste diverted (salvaged and recycled) as a percentage of total waste
- D. Other Submittals:
1. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations.
  2. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations.
  3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
  4. Landfill Disposal Records: Indicate receipt and acceptance of waste by landfills facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
  5. Wood Derived Fuel Processing Facility Records: Indicate receipt and acceptance of materials by (WDF) processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

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

**2. PRODUCTS (NOT USED)**

**3. EXECUTION**

**3.1 ON-SITE OPERATIONS**

- A. **Manager:** The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- B. **Distribution:** The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, and the Owner's Representative.
- C. **Instruction:** The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
- D. **Separation Facilities:** The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to the Owner's Representative.
  1. **Commingling Waste:** Commingling waste at the job site may be allowed, provided that the following conditions are met:
    - a. Comminglers shall be included in the Construction Waste Management Plan (CWMP)
    - b. Additional comminglers must be pre-approved by the Architect via CWMP addenda, prior to tipping on the job site.
- E. **Hazardous Wastes:** Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations and as directed by the Owner.

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**SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT PLAN EXAMPLE**

Worksheet available for download here: [http://www.cf.missouri.edu/cf/pdc/contractor\\_information](http://www.cf.missouri.edu/cf/pdc/contractor_information)

Construction Waste Management Report													
Recycled, Diverted, and Reused Materials - ACTUAL													
Matl.	Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
<b>Concrete Rubble</b>													
		mm/dd/yyyy	eg: Clean Fill		eg: Somename Rd.	eg: Demolition						0.00	0.00
												0.00	
<b>Dimensional Lumber and Wood Cut Pieces</b>													
		mm/dd/yyyy	eg: ACME Inc. Compost		eg: misc wood	eg: Demolition						0.00	0.00
												0.00	
<b>Clean Gypsum Wallboard</b>													
		mm/dd/yyyy	eg: ACME Inc. Compost		eg: gyp board	eg: Demolition						0.00	0.00
												0.00	
<b>Doors &amp; Frames</b>													
		mm/dd/yyyy	eg: SomeGroup Donation		eg: wood trim	eg: Demolition						0.00	0.00
												0.00	
<b>Steel</b>													
		mm/dd/yyyy	eg: ACME Inc. Recycling		eg: steel	eg: Demolition						0.00	0.00
												0.00	
<b>Cardboard &amp; Paper</b>													
		mm/dd/yyyy	eg: ACME Inc. Recycling		eg: pkg boxes							0.00	0.00
												0.00	
<b>Scrap Metal</b>													
		mm/dd/yyyy	eg: ACME Inc. Recycling		eg: zinc/steel	eg: Demolition						0.00	0.00
												0.00	
<b>Carpet &amp; Padding</b>													
		mm/dd/yyyy	eg: ACME Carpeting & Flooring		eg: carpet	eg: Demolition						0.00	0.00
												0.00	
<b>Casework</b>													
		mm/dd/yyyy	eg: University Salvage		eg: casework	eg: Demolition						0.00	0.00
												0.00	
<b>Miscellaneous Equipment</b>													
		mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
												0.00	
<b>ACTUAL Total Waste Diverted</b>												<b>0.00</b> (lbs)	
Landfill Materials Description - ACTUAL													
Matl.	Stream	Date	Diversion Method / Location	Receipt #	Notes (Material)	Source	Units	Cubic Feet	Square Feet	Lineal Feet	Per Unit (lbs)	Weight (lbs)	Total Stream Weight (lbs)
<b>General Mixed Waste</b>													
		mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
												0.00	
<b>Alternative Daily Cover</b>													
		mm/dd/yyyy	eg: ACME International Inc.		eg: misc	eg: Demolition						0.00	0.00
												0.00	
<b>ACTUAL Total Waste to Landfill</b>												<b>0.00</b> (lbs)	
Total Construction Waste - ACTUAL												<b>0.00</b>	
Percentage of Waste Diverted From Landfill - ACTUAL												<b>0.00%</b>	

END OF SECTION 01 74 19

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## **SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
- B. Owner's Project Requirements (OPR) documentation prepared by Owner contains requirements that apply to this Section.
- C. Related Sections include the following:
  - 1. Section 220800, Plumbing Commissioning Requirements, for specific requirements for commissioning Plumbing systems.
  - 2. Section 230800, Mechanical Commissioning Requirements, for specific requirements for commissioning HVAC systems.
  - 3. Section 260800, Electrical Commissioning Requirements, for specific requirements for commissioning HVAC systems.
  - 4. Divisions 22, 23 and 26 Sections - Individual Sections stipulate installation, startup, warranty and training requirements for the system or device specified in that Section.

#### **1.2 REFERENCES**

- A. ASHRAE Guideline 0-2013: The HVAC Commissioning Process.
- B. ANSI/NEBB S110-2018 - Whole Building Technical Commissioning of New Construction

#### **1.3 DEFINITIONS**

- A. Acceptance Phase - The phase of the project when the facility and its systems and equipment are inspected, tested, and verified. Most of the functional performance testing and formal training occurs during this phase of the project. It will generally occur after the Construction Phase is complete including execution of checklists and startup. The Acceptance Phase typically begins with Substantial Completion and ends with Functional Completion.
- B. ASHRAE - American Society of Heating, Refrigeration, and Air-Conditioning Engineers



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- C. **Basis-of-Design Document (BoD):** A document, prepared by the designers, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- D. **Commissioning (Cx) -** The process of verifying all building systems are installed and perform interactively according to the design intent; the systems are efficient, cost effective and meet the Owner's operational needs; the installation is adequately documented; and operating personnel are adequately trained.
- E. **Commissioning Authority (CxA) -** An individual or company who will oversee the commissioning process; stipulate many of the commissioning requirements; and verify that systems and equipment are designed, installed and tested to meet the Owner's requirements.
- F. **Commissioning Team -** A group of individuals who will collaborate to ensure the facility is fully and completely commissioned. This team will include the Commissioning Authority, the Owner's representative, the TAB contractor and a commissioning coordinator provided by the Contractor. Generally the installing contractor, subcontractor and manufacturer will also be an integral member of the team for any given system or equipment.
- G. **Construction Phase –** The phase of the project during which the facility is constructed and/or systems and equipment are installed and started. During this phase Contractors complete installation startup forms, submit operation and maintenance (O&M) information, establish trends, etc. The Construction Phase will generally end upon the completed startup and TAB of systems and equipment.
- H. **Contractor -** As used herein is a general reference to the applicable installing party and can therefore refer to the construction manager, general contractor, subcontractors, or vendors.
- I. **Deficiency -** An installation or condition that is not in conformance with the construction documents and/or the design intent.
- J. **Functional Completion -** A milestone that marks the successful completion of the Acceptance Phase. It generally includes the functional performance testing of the systems in the initial season.
- K. **Functional Performance Testing -** The dynamic testing of systems and equipment under various modes of operation and different conditions. Both component performance and environmental objectives will be monitored during this testing.
- L. **NEBB -** National Environmental Balancing Bureau
- M. **Owner's Project Requirements (OPR):** A written document prepared by Owner's Representative detailing the functional requirements of Project and expectations of how it

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will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

- N. Party - Individual, company or entity involved in the construction and commissioning activities of the project. Refer to the Commissioning Plan for names, roles and responsibilities.
- O. Prefunctional Check – The static testing of equipment to establish that the equipment has been installed correctly.
- P. Scheduled Outage – A period of time scheduled by the Owner in which the system is out of service or not in use by the occupants.
- Q. Startup - A process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the startup checklist, and energizes the device or system, and verifies it is in proper working order.
- R. Systems, Subsystems, and Equipment - Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- S. TAB - Testing, Adjusting and Balancing as specified in Section 230593.
- T. Warranty Phase - Includes the early occupancy of the building and continues through the warranty period into the opposite season from when the system was initially tested.

#### 1.4 GENERAL DESCRIPTION

- A. Commissioning is a process to assure all building systems are installed and perform interactively according to the design intent; the systems are efficient, cost effective and meet the Owner's operational needs; the installation is adequately documented; and operating personnel are adequately trained. Commissioning serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance building systems from installation to fully optimized operation.
- B. The Commissioning Authority will work with the Contractor and Design Engineer to coordinate, oversee, and document the commissioning process during the Construction and Occupancy/Acceptance Phases of this project.
- C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
  - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - 2. Verify and document proper performance of equipment and systems.

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3. Verify that O&M documentation left on site is complete.
  4. Verify that the Owner's operating personnel are adequately trained.
- D. Commissioning does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product, nor does it replace the contractor's quality assurance and quality control responsibilities. Commissioning is the Owner's QA/QC and is not intended to be the Contractors QA/QC or project completion list.

### 1.5 COMMISSIONING TEAM

- A. Members Appointed by the Construction Manager, Sub Contractors, Architect and Engineer approved by the Owner's Representative: Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including project superintendent, architect and engineering design professionals, and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
1. Representatives of the facility user and operation and maintenance personnel.
  2. Architect and engineering design professionals who are not the Architect/Engineer designers of record.

### 1.6 COMMISSIONING PROCESS

- A. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
  2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
  3. Equipment documentation is submitted to the CxA during normal submittals, including detailed startup procedures.
  4. Detailed equipment start-up plans shall be submitted by the contractors. The CxA will review contractor submitted start-up plans in conjunction with the Owner. This includes review of any temporary system operational plans (if allowed by the Owner).
  5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.

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6. The Contractors, under their own direction, execute and document the forms and checklists included in the startup plans. The CxA documents that the startup was completed according to the approved plans. This may include the CxA witnessing startup of selected equipment.
7. The Commissioning Authority will review the submittal documents and the early operations and maintenance (O&M) material and develop functional testing procedures. The functional testing procedures will be reviewed with the design team and subcontractors as necessary to clarify operation.
8. The functional tests are executed by the Contractors, under the direction of, and documented by the CxA.
9. The CxA reviews equipment performance trend data obtained during the maximum heating and cooling seasons.
10. The CxA reviews the O&M documentation for completeness and accuracy.
11. The CxA reviews the training provided by the Contractors and verifies that it was completed.
12. Deferred testing is conducted, as specified or required.

#### 1.7 OWNER'S RESPONSIBILITIES

- A. Coordinate the Owner's operation and maintenance personnel and engineering staff to schedule them to participate in commissioning team activities including, but not limited to, the following:
  1. Commissioning coordination meetings
  2. Training in operation and maintenance of systems, subsystems, and equipment
  3. Testing meetings
  4. Demonstration of operation of systems, subsystems, and equipment
  5. Review and approve final commissioning documentation.
- B. Provide the OPR documentation to the CxA for use in developing the commissioning plan; operation and maintenance training plan; and testing plans and checklists.

#### 1.8 MECHANICAL AND ELECTRICAL DESIGNER/ENGINEERS (of the A/E)

- A. Provide any design and control sequence narratives requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

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- B. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
- C. Review and approve the contractor submittals and O&M manuals.
- D. Review the functional test procedure forms for major pieces of equipment for sufficiency prior to their use.
- E. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during warranty-period commissioning.

### 1.9 CONTRACTOR'S RESPONSIBILITIES

- A. Facilitate the coordination of the commissioning work by the CxA, and ensure that commissioning activities are being included in the project schedule.
- B. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
- C. Furnish a copy of all construction documents, addenda, change orders, and approved submittals and shop drawings related to commissioned equipment to the CxA.
- D. Where acceptance testing is to be executed by the system/equipment provider, the Contractor, with the CxA's assistance, will develop final acceptance test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
  - 1. Name and/or identification of tested item
  - 2. Time and date of test
  - 3. Deficiencies with issue number, if any, generated as the result of test
- E. Review commissioning progress and deficiency reports.
- F. Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning.
- G. Assist the CxA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.
- H. Certificate of Readiness shall be provided and signed by Contractor, sub-contractor(s), and installer(s) for each system certifying that all subsystems, equipment, test and balancing,

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and associated controls are ready for testing. Completed startup plan checklists shall accompany this certificate.

- I. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
  1. Participate in construction-phase commissioning coordination meetings.
  2. Participate in maintenance orientation and inspection.
  3. Participate in operation and maintenance training sessions.
  4. Certify that Work is complete and systems are operational according to the Contract Documents, including test and balancing and calibration of instrumentation and controls.
  5. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  
- J. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:
  1. Participate in construction-phase commissioning coordination meetings.
  2. Participate in maintenance orientation and inspection.
  3. Provide information to the CxA for updating construction-phase commissioning plan.
  4. Contractors shall review the Owner-approved training agendas and provide the coordinated training schedule, location, trainer name and contact information and submit for approval.
  5. Participate in training sessions for the Owner's operation and maintenance personnel.
  6. Provide updated Project Record Documents to the CxA on a regular basis.
  7. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CM and CxA, as specified in Section 017823, Operation and Maintenance Data.

#### 1.10 CxA'S RESPONSIBILITIES

- A. The CxA (AccuTec Services, Inc.) has been retained by the Owner.
  
- B. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving of non-conformance or deficiencies, but ultimately that responsibility resides with the CM and the A/E. The primary role of the CxA

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is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents.

- C. Substitutions, changes, and increases or decreases in scope proposed by the CxA shall be sent to the Owner for action and approval. No substitutions, changes, increases, or decreases in scope shall be implemented by the CxA prior to written Owner approval.
- D. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor startup and checkout procedures.
- E. Prepare a construction-phase commissioning plan. Collaborate with the Contractor and subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities by name, firm, and trade specialty, for performance of each commissioning task.
- F. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.
- G. Review and comment on submittals from Contractor and each subcontractor for compliance with the OPR, BoD, Contract Documents, and construction-phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BoD.
- H. CxA shall hold commissioning team meetings no less frequently than monthly and as frequently as weekly, depending on the current level of commissioning activities. Meetings shall be held for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include preparing agenda and attendance lists, and issuing meeting minutes to commissioning team members.
- I. The CxA will review submittals, including detailed start-up procedures and develop the detailed field Prefunctional Checklists. These checklists will be used by the Commissioning Authority to verify and document proper and complete installation of the systems and their components.
- J. Visit the site no less than once per month, and attend all key events during the build phase and perform commissioning activities. The CxA shall increase visit frequency as necessary as the project progresses to equipment start-up and functional testing.
- K. Prepare Project-specific test procedures and checklists.
- L. The CxA, with the Contractor's assistance, will develop final functional test checklists for each system, subsystem, or equipment including interfaces and interlocks.

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- M. Witness all or part of the HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed. Notify Owner of any deficiencies in results or procedures.
- N. Witness all or part of the ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Notify Owner of any deficiencies in results or procedures.
- O. Witness all or part of the equipment startup procedures of equipment and subsystems to be commissioned, sufficient to be confident that proper procedures were followed. Notify Owner of any deficiencies in results or procedures.
- P. Execute prefunctional checklists for each piece of equipment and subsystem to be commissioned as they are installed to verify that installations are in compliance with the project requirements.
- Q. Approve equipment/systems installation and startup completion by reviewing contractor-executed startup plan checklists and by selected site observation and spot checking.
- R. Review TAB execution plan.
- S. Perform TAB verification as required per specification 230800.
- T. Assist the Owner in the verification of startup date and acceptance for each item of equipment for start of warranty periods.
- U. Compile test data, and certificates and include them in the commissioning report.
- V. Analyze any functional performance trend logs and monitoring data to verify performance.
- W. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Section 017839, Project Record Documents.
- X. Review and comment on operation and maintenance documentation for compliance with the OPR, BoD, and Contract Documents. Operation and maintenance documentation requirements are specified in Section 017823, Operation and Maintenance Data.
- Y. Assist the Construction Manager in developing a training plan. Operation and maintenance training is specified in Section 017900, Demonstration and Training.
- Z. Maintain commissioning record for each piece of equipment and subsystem to be commissioned.
- AA. Provide a written commissioning report following the commissioning team acceptance of all functional performance and integrated systems tests.



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## 1.11 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by the CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:
1. Plan for delivery and review of submittals and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes.
  2. Identification of systems and equipment to be commissioned.
  3. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
  4. Identification of items that must be completed before the next operation can proceed.
  5. Description of responsibilities of commissioning team members and listing of contact information for each party.
  6. Description of requirements for operation and maintenance training, including required training materials.
  7. Schedule for commissioning activities to be coordinated with overall construction schedule.
  8. Process and schedule for completing prestart and startup and prefunctional checklists for systems, subsystems, and equipment to be verified and tested.
  9. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
- B. Functional Test Checklists: Final functional test checklists shall include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Specific checklist content requirements are specified in Section 230800 Mechanical Commissioning Requirements. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
1. Name and/or identification of tested item.
  2. Time and date of test.
  3. Deficiencies with issue number, if any, generated as the result of test.
- C. Certificate of Readiness: Certificate of Readiness shall be provided and signed by Contractor, sub-contractor(s), and installer(s) for each system certifying that all subsystems, equipment, and associated controls are ready for testing. Completed startup plan checklists shall accompany this certificate.
- D. Functional Test and Observation Reports: CxA shall record functional test data, observations, and measurements on test checklists. Screenshots, forms, and other means

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appropriate for the application shall be included with data. CxA shall compile test and observation reports and include them in the commissioning report.

- E. Commissioning Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.
1. All deficiencies or non-conformance issues shall be noted and reported to the Commissioning Team on the commissioning issues log. The project issues log is to be updated daily and available for viewing by the commissioning team via the project website.
  2. On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:
    - a. Issue number and title.
    - b. Date of the identification of the issue.
    - c. Issue status
  3. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the commissioning issues log.
  4. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
- F. Commissioning Records: Commissioning records shall include, at a minimum, the following:
1. List of participants and roles
  2. Brief equipment/subsystem description
  3. Overview of commissioning and testing scope
  4. Description of testing and verification methods
  5. Disposition of the CxA regarding the adequacy of the commissioned equipment or subsystems, documentation, and training in meeting the project requirements
  6. Issues log specific to the commissioned equipment or subsystem.
  7. O&M manual reviews
  8. Applicable observation reports
  9. Training records

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10. Construction checklist
  11. Certificates of Readiness
  12. Contractor startup plans and reports
  13. Functional test plans and results.
- G. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall include, but is not limited to, the following:
1. All commissioning records with a summary of findings and dispositions of equipment and subsystems during commissioning, and recommendations
  2. Issues log
  3. Listing of off-season test(s) not performed and a schedule for their completion
  4. OPR and BoD documentation.
  5. Commissioning plan.

#### 1.12 SUBMITTALS

- A. Commissioning Plan Draft Submittal: CxA shall submit electronically formatted draft commissioning plan to the commissioning team for review. One copy, with review comments, will be returned to the CxA for preparation of the final construction phase commissioning plan.
- B. Commissioning Plan Final Submittal: CxA shall submit electronically formatted final commissioning plan to the commissioning team. The final submittal must address previous review comments.
- C. Final Commissioning Report Submittal: CxA shall submit an electronically formatted final commissioning report. The final submittal must address any previous review comments.

#### 1.13 QUALITY ASSURANCE

- A. Training Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments.

### **PART 2 PRODUCTS (Not Used)**

GENERAL COMMISSIONING REQUIREMENTS

01 91 13 - 12

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## **PART 3 EXECUTION**

### **3.1 SYSTEMS TO BE COMMISSIONED**

A. The following systems shall be commissioned, including but not be limited to:

B. Equipment and Systems – HVAC

1. Hot Water Systems (Service Water)
2. Chilled Water Systems
3. Heating Hot Water Systems
4. Steam and Condensate Systems
5. Air Handling Systems
6. Supply and Exhaust Terminal Units
7. Specialty Fans
8. Filtration Systems
9. Variable Frequency Drives
10. Building Automation System
11. Building Pressures
12. Life Safety Systems
  - a. Fire/Smoke Dampers
  - b. HVAC Equipment Shutdown via Fire Alarm

C. Plumbing Systems

1. Compressed air and CO2
2. Domestic hot and cold water to new fixtures
3. Effluent System

D. Equipment and Systems – Controls

1. Building Automation System
2. Variable Frequency Drives

E. Equipment and Systems – Electrical

1. Emergency Power Distribution including failure testing
2. Normal Power Distribution
3. Grounding Systems

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### 3.2 STARTUP CHECKLISTS

- A. The following procedures apply to all equipment to be commissioned, according to Section 3.1, Systems to be Commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified startup plans.
- B. General: Startup checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The startup checklists for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Startup Plan: The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed startup plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
  - 1. The contractor responsible for the purchase of the equipment develops the full startup plan by combining (or adding to) the representative checklists and procedures from specifications 230800 and/or 260800 with the manufacturer's detailed startup and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
  - 2. The full startup plan could consist of something as simple as:
    - a. The approved startup checklists.
    - b. The manufacturer's standard written startup procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
    - c. The contractor's normally used field checkout sheets.
  - 3. The contractor submits the full startup plan to the CxA for review and approval.
  - 4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
  - 5. The approved startup plan is provided to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.
- D. Execution of Startup Plan
  - 1. Four weeks prior to startup, the Contractors and vendors schedule startup and checkout with the CM and CxA. The performance of the startup plans are directed

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- and executed by the Contractor. When checking off prefunctional checklists, signatures may be required of other Contractors for verification of completion of their work.
2. The Contractors and vendors shall execute the startup and provide the CxA with a signed and dated copy of the completed startup plans.
  3. Only individuals that have direct knowledge and witnessed that a line item task on the startup plan was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
  4. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party.

### 3.3 FUNCTIONAL PERFORMANCE TESTING

- A. **Objectives and Scope:** The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall also be tested.
- B. **Development of Test Procedures.** Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in Section 230800, the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Contractor or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures review (e.g. answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Commissioning Team to review for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested.
- C. **Coordination and Scheduling:** The Contractor shall provide sufficient notice to the CxA prior to commencement of any equipment/system startup, acceptance testing, inspection, demonstrations, or other events which form a part of formal acceptance. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Contractors shall execute the tests. In general, functional testing is conducted after startup has been satisfactorily completed. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper

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performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

- D. Problem Solving. The CxA may recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractor and A/E.
- E. Opposite Season Testing: Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. "Opposite season" testing will be required where scheduling prohibits thorough testing in all modes of operation.

### 3.4 DOCUMENTATION OF NON-CONFORMANCE AND APPROVAL OF TESTS

#### A. Creating an Issues Log Entry:

1. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
2. Identify date of the issue.
3. Identify system, subsystem, and equipment to which the issue applies.
4. Include information that may be helpful in diagnosing or evaluating the issue.
5. Identify person documenting the issue.

#### B. Documenting Issue Resolution:

1. Log date correction is completed or the issue is resolved.
2. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
3. Identify changes to the OPR, BoD, or Contract Documents that may require action.
4. State that correction was completed and system, subsystem, and equipment are ready for retest, if applicable.
5. Identify person(s) or Cx Team member who corrected or resolved the issue.
6. Identify person(s) documenting the issue resolution.

#### C. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

1. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:

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- a. The CxA documents the deficiency and the Contractor's intentions and testing proceeds.
  - b. Once the Contractor has corrected the deficiency, the CxA shall be notified in writing that the issue has been FIXED certifying that the equipment is ready to be retested.
  - c. The test is repeated and the deficiency status will be changed to either ACCEPTED to close the issue or, if the issue was not properly resolved, the issue status will be will changed back to OPEN.
2. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
    - a. The deficiency shall be documented on the project commissioning issues log with the Contractor's response and issued to the Commissioning Team.
    - b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority and acceptance authority is with the Owner.
    - c. The CxA documents the resolution process on the project deficiency log.
    - d. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and the CxA shall be notified in writing that the issue has been FIXED certifying that the equipment is ready to be retested. The test is repeated until satisfactory performance is achieved.
- D. Cost of Retesting
1. For a deficiency identified, not related to any prefunctional checklist or startup fault, the following shall apply: The equipment will be retested once under the original contract. However, the CxA's time for a second retest will be charged to the Owner, who may choose to recover costs from the Contractor.
  2. The time for the CxA to direct any retesting required because a specific prefunctional checklist or startup test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be charged to the Owner, who may choose to recover costs from the Contractor.
  3. The Contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
  4. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.
- E. Functional Test Approval: The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA. The CxA recommends acceptance of each test to the Owner using a standard form. The Owner gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.



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### 3.5 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Owner. These tests will be conducted in the same manner as the seasonal tests as soon as possible.
- B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Section 230800 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Contractors, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made.

END OF SECTION 019113

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## **SECTION 02 41 19 - SELECTIVE DEMOLITION**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.

#### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 MATERIALS OWNERSHIP

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

#### 1.5 PREINSTALLATION MEETINGS

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

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

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- 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. Pre-demolition Photographs or Video: Submit before Work begins.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.

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- 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.

1.8 WARRANTY

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

**PART 2 PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

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

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

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### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  2. Arrange to shut off indicated utilities with utility companies.
  3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- B. Existing Services/Systems to Be Remain: Where services and systems that are to remain are impacted by the removal or demolition of other work (i.e. removal of ceiling grid that support lights and/or diffusers), the Contractor shall restore the services and systems back to original operation and/or location using materials, supports, and requirements outlined in the project specifications without additional compensation.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

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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.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.4 SELECTIVE DEMOLITION, GENERAL

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

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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, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.7 CLEANING

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

END OF SECTION 02 41 19

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## **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Slabs-on-grade.

#### **1.3 ACTION SUBMITTALS**

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

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, manufacturer and testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.



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2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

## PART 2 PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials.

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- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

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## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I or Type III, gray. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F or C.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source. Coarse aggregates shall meet the requirements for use in regions of moderate weathering.
  - 1. Nominal aggregate sizes shall not exceed Maximum Coarse Aggregate Sizes for each Concrete Mixture.
- C. Water: ASTM C 94/C 94M.

## 2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.7 CONCRETE MIXTURES, GENERAL

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

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1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  1. Use water-reducing admixture in concrete, as required, for placement and workability.

## 2.8 FABRICATING REINFORCEMENT

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

## 2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
  1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## 2.10 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

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- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

## 2.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: 4500 psi at 28 days.
  - 4. Install #4 dowels to connect concrete base to concrete floor. Unless otherwise indicated, install #4 dowels on 18-inch centers around the full perimeter of concrete base with a minimum of 4 dowels per base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
  - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

## 2.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

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- C. Formed Surfaces: Cure formed concrete surfaces, If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

END OF SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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## **SECTION 04 26 13 - MASONRY VENEER**

### **PART 1 GENERAL**

#### 1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Concrete masonry units.
3. Concrete face brick.
4. Mortar materials.
5. Ties and anchors.
6. Embedded flashing.
7. Accessories.
8. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in masonry veneer.
2. Steel lintels in masonry veneer.
3. Steel shelf angles for supporting masonry veneer.

#### 1.2 DEFINITIONS

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

#### 1.3 ACTION SUBMITTALS

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

- B. Samples for selection: For each type and color of the following:

1. Clay face brick – match existing color/texture.
2. Decorative CMUs – match existing color/texture.
3. Weep/cavity vents.
4. Colored Mortar

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates:



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1. Masonry units.
    - a. Include data on material properties.
    - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
  2. Cementitious materials. Include brand, type, and name of manufacturer.
  3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  4. Grout mixes. Include description of type and proportions of ingredients.
  5. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

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1.7 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

1.8 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 finished.
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.

- B. Face Brick: Facing brick complying with ASTM C 216.

1. Products: Subject to compliance with manufacturer requirements.
2. Grade: SW.
3. Type: FBX
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Provide face brick matching color range, texture, and size of existing adjacent brickwork.

1.9 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

- B. Concrete Face Brick: ASTM C1634, normal weight.

1. Texture: Split-face to match existing.
2. Colors: Match existing.

1.10 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

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

1.11 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

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

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Tie Section: Triangular-shaped wire tie made from 0.25-inch diameter.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1.12 EMBEDDED FLASHING

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 25 mil thick, with a 15-mil thick coating of adhesive.

a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer. Provide stainless steel drip edge at termination to exterior.

1.13 ACCESSORIES

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

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1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

#### 1.14 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.

### PART 2 EXECUTION

#### 2.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 2.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

#### 2.3 LINTELS

- A. Install steel lintels where indicated.

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- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

## 2.4 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. 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.
- B. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

## 2.5 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

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6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 26 13

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## **SECTION 04 72 00 - CAST STONE MASONRY**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Cast stone trim.
- B. Related Sections:
  - 1. Section 04 26 13 "Masonry Veneer" for installing cast stone units in unit masonry.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
  - 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples for Selection: For colored mortar.
- D. Samples for Verification:
  - 1. For each color and texture of cast stone required, 10 inches square in size.
  - 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project.



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#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
  - 1. Include copies of material test reports for completed projects, indicating compliance of cast stone with ASTM C 1364.
- B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
  - 1. Provide test reports based on testing within previous two years.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.
- B. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
  - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
  - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

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## 1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

## PART 2 PRODUCTS

### 2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
  - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
  - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
  - 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
  - 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.

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## 2.2 CAST STONE UNITS

- A. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
  - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  - 3. Provide drips on projecting elements unless otherwise indicated.
- C. Fabrication Tolerances:
  - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch .
  - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch , whichever is greater, but in no case by more than 1/4 inch .
  - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch , whichever is greater.
- D. Cure units as follows:
  - 1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
  - 2. Keep units damp and continue curing to comply with one of the following:
    - a. No fewer than five days at mean daily temperature of 70 deg F or above.
    - b. No fewer than six days at mean daily temperature of 60 deg F or above.
    - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
    - d. No fewer than eight days at mean daily temperature of 45 deg F) or above.
- E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- F. Colors and Textures: Match existing units.

## 2.3 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 04 26 13 "Masonry Veneer."

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**PART 3 EXECUTION**

3.1 EXAMINATION

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

3.2 SETTING CAST STONE IN MORTAR

3.3 TAR

- A. Install cast stone units to comply with requirements in Section 04 26 13 "Masonry Veneer."

END OF SECTION 04 72 00

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## **SECTION 05 40 00 - COLD-FORMED METAL FRAMING**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Exterior non-load-bearing wall framing.
  - 2. Roof rafter framing.

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: For cold-formed steel framing.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

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1. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Miscellaneous structural clips and accessories.

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

## 1.6 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.7 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ClarkDietrich Building Systems.
  2. MarinoWARE.
  3. Nuconsteel; a Nucor Company.
  4. Steel Network, Inc. (The).
  5. Telling Industries.
  6. Or equal if and as specifically approved by Architect by Addendum during the bidding period.

### 2.2 COLD-FORMED STEEL FRAMING, GENERAL

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

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- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
  - 1. Grade:
    - a. 0.0428 inch and lighter members: ST33H.
    - b. 0.0538 inch and heavier members: ST50H.
  - 2. Coating: G60, A60, AZ50, or GF30.
- C. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: 50.
  - 2. Coating: G60.

### 2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches.
  - 3. Section Properties: As Indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-1/4 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches.
  - 3. Section Properties: As Indicated.
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Top Flange Width: 1-5/8 inches.
  - 3. Section Properties: As Indicated.



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## 2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-1/4".
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches.
  - 3. Section Properties: As Indicated.
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
- E. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ClarkDietrich Building Systems.
    - b. Simpson Strong-Tie.
    - c. Steel Network, Inc. (The).
    - d. Or equal if and as specifically approved by Architect by Addendum during the bidding period.

## 2.5 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: 0.0538 inch.
  - 2. Flange Width: 1-5/8 inches, minimum.
  - 3. Section Properties: As Indicated.

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## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness, not less than thickness of framing members, and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Joist hangers and end closures.
  - 7. Backer plates.

## 2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

## 2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

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

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

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

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### 3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- 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 or screw fastening. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

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- H. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.4 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: To match stud spacing.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
  - 1. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

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1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.
  1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
  2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
  1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
- E. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- F. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

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1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  2. Bridging: Combination of flat, taut, steel straps and stud track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
    - a. Flat strap Minimum Base Metal Thickness: 0.0538 inches.
    - b. Flat Strap Width: 2 inches.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.6 JOIST INSTALLATION

- 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.
  2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
  1. Joist Spacing: 12 inches.
- 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, or as indicated.
  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. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.

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2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking 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.

### 3.7 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. Remove and replace work where test results indicate that it does not comply with specified requirements.

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

### 3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

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

END OF SECTION 05 40 00



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## **SECTION 05 50 00 - 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. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- 2. Shelf angles.

#### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. 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, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

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1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

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

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. 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.

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 A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M

2.3 FASTENERS

- A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers
- B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- C. Post-Installed Anchors: Torque-controlled expansion anchors .
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

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## 2.4 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. 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.

## 2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

## 2.6 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.

## 2.7 FINISHES, GENERAL

- 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.

## 2.8 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

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1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

### **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.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

#### **3.2 INSTALLING 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.
  1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

END OF SECTION 05 50 00

METAL FABRICATIONS

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## **SECTION 06 10 00 - 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 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 fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

#### **1.4 INFORMATIONAL SUBMITTALS**

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

#### **1.5 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.

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## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 4. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

### 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

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3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
  1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
  1. Roof construction.

### 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.
- B. For items of dimension lumber size, provide Construction or No. 2 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.

## PART 3 EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, 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.



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1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
  
- C. 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.

END OF SECTION 06 10 00

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## **SECTION 06 16 00 - SHEATHING**

### **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. Wall sheathing.
- 2. Roof sheathing.
- 3. Sheathing joint and penetration treatment.

- B. Related Requirements:

- 1. Section 07 25 00 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

#### 1.3 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 fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
- 2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:

- 1. Fire-retardant-treated plywood.

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## 1.5 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.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.1 WOOD PANEL PRODUCTS

- A. Plywood: DOC PS 1.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

### 2.2 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is

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indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings.

### 2.3 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
  - 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. Certainteed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. National Gypsum Company.
    - d. USG Corporation.
    - e. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
  - 2. Type and Thickness: Type X, 5/8 inch thick.
  - 3. Size: 48 by 96 inches for vertical installation.

### 2.4 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exposure 1 sheathing.
  - 1. Span Rating: As required to suit stud spacing indicated.
  - 2. Nominal Thickness: Not less than 3/4 inch.

### 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

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- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
  - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
  - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

## 2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## 2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

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3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
- D. Use common wire 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. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  1. Wall and Roof Sheathing:
    - a. Screw to cold-formed metal framing.
    - b. Space panels 1/8 inch apart at edges and ends.

### 3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

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D. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 16 00

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## **SECTION 06 83 15 – ACRYLOYL ENGINEERED POLYMER WALL AND CEILING PANELS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes:
  - 1. Acryloyl engineered polymer panels and accessories for interior walls and ceilings.
    - a. Spline, joint covers, mastic, finishing compound, sealants, fasteners, and other components required for a complete, hermetically sealed, wall and ceiling assembly.
    - b. Finishing accessories.
- B. Related Sections:
  - 1. Section 092216 - Non-Structural Metal Framing

#### **1.3 REFERENCES**

- A. ASTM D 523 - Standard Test Method for Specular Gloss.
- B. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- C. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties.
- F. ASTM D 1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- G. ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impresser.
- H. ASTM E 84 - Surface Burning Characteristics of Building Materials.
- I. ISO 9705-Annex B: 1993 (E) Full-scale room test.
- J. Classification of Reaction to Fire Performance in accordance with EN 13501-1 + A1.
- K. Canadian Military Standard (Mils) 1073.2 - Impact Resistance Test.
- L. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
- M. New York City MEA Approval 414-04-M - University of Pittsburgh Test Protocol for Measurement of Acute Lethality of Thermal Decomposition Products from Specimen.
- N. ASTM E 831 – Standard Test Method for Linear Thermal Expansion of Solid Materials by Thermo-Mechanical Analysis



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- O. Seismic Testing – Seismic requirements of NAS 4219 and ICC-ES AC156 (US) for Arcoplast wall and ceiling system
- P. ISO 846 - Plastics - Evaluation of the action of microorganisms- Resistance to Fungi & Bacteria Test method
- Q. ASTM D 3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- R. ASTM D 3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation
- S. ISO 2812-4 and ASTM D1308-02 - Chemical Resistance Testing of Arcoplast engineered polymer panels
- T. Determination of Extractives Residue according to US FDA 21 CFR 177.2600 Arcoplast finishing compound/sealant

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data including installation instructions.
- B. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating composite ceiling panels, wall panels, wall base, joints, radius joints, finish junctions at wall-to-wall, wall-to-ceiling, wall-to-floor, wall-to-window/door frames, mastic or tape adhesive, and attachment screws.
  - 1. Indicate size and location of wall openings and penetrations.
  - 2. Indicate items to be supported by walls. Include loads.
  - 3. Indicate method of sealing joints, openings, and penetrations.
  - 4. Suspension system spacing and details.
  - 5. Splicing, joint treatment, and fastening details of ceiling panels.
  - 6. Changes in ceiling planes, openings, and intersections with vertical element.
  - 7. Ceiling access door dimensions and location.
- C. Samples: Submit manufacturer's samples.
  - 1. Composite ceiling panels.
  - 2. Composite wall panels.
  - 3. Wall base.
  - 4. Attachment joints.
  - 5. Finishing compound detailing.
- D. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- E. Warranty: Submit manufacturer's standard warranty. The manufacturer guarantees the product supplied shall be free of defects in material or workmanship under normal use and service.
  - 1. Warranty Period: Five years from date of delivery.

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## 1.5 QUALITY ASSURANCE

- A. **Manufacture Qualifications:** Provide at time of bid; a list of references and comparable installations for Owner and Architect to contact and visit.
- B. **Installer Qualifications:** An experienced installer certified by composite panel Manufacturer for type of installation required.
- C. **Mockups:** Before installing entire installation, build ROOM MOCK-UP to demonstrate mechanics, aesthetic effects and set quality standards for materials and execution.
  - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. **Source Limitations:** Obtain engineered polymer panels and accessories from single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. **Delivery:** Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. **Storage:**
  - 1. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
  - 2. Composite Panels: Store flat.
  - 3. Finishing Compound: Store for a maximum of 6 months from date of shipment at temperature of 50 degrees F to 80 degrees F (10 degrees C to 27 degrees C).
  - 4. Adhesive: Store for a maximum of 6 months from date of shipment at temperatures below 80 degrees F (27 degrees C).
- C. **Handling:** Protect materials and finish from damage during handling and installation in accordance with manufacturer's instructions.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install materials until building is enclosed and areas to receive materials are protected from dirt and dust.
- B. Maintain the following conditions during and after installation in areas to receive materials.
  - 1. Minimum Temperature: 60 degrees F (15 degrees C).
  - 2. Relative Humidity: 20 to 60 percent.

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## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Basis of Design: Subject to compliance with requirements, provide the following by Arcoplast, 1873 Williamstown Drive, St. Peters, Missouri 63376. Toll Free (888) 736- 2726. Phone (636) 978-7781. Fax (636) 978-7782. Web Site [www.arcoplast.com](http://www.arcoplast.com).

1. Acryloyl for BSL-3 Ag Environment

- B. The following components meet critical environment and high containment facility requirements. SUBSTITUTION ARE NOT ALLOWED.

### 2.2 ACRYLOYL ENGINEERED POLYMER WALL AND CEILING PANELS

- A. Wall and Ceiling Panels: Acryloyl engineered polymer panels impregnated with fire-rated resin and fire-rated fillers.

1. Panel Thickness:

- a. Applied to Metal Stud: 3/8 inch (12mm).

2. Size:

- a. Modular, 4' (1.2m) wide (up to 20' (6m) long.

- 1) Side Edge Profile: Eased Side Edge Grooved.
- 2) End Cut Profile: Grooved.
- 3) Joint System: Mechanical Spline.

3. Color: To be selected from manufacturers full line of available colors.

- B. Physical Properties of Acryloyl Engineered Polymer Panels: 1/2-inch thickness (12mm).

1. Tensile Strength, ASTM D 638-03: 3740 psi.
2. Flexural Strength, ASTM D 790-03: 8070 psi.
3. Compressive Strength 12502 psi.
4. Barcol Hardness, ASTM D 2583: 58.
5. Water Absorption of Plastic, ASTM D 570: 0.04%
6. Surface Burning Characteristics, ASTM E 84 and CAN/ULC-S102-10, Whole Panel, Class A:

- a. Flame Spread Index: 25.
- b. Smoke Development: 450.

7. Gloss Property, ASTM D 523: 97.8 reflectance at 85-degree light source.
8. Toxicity Test - UPITT Protocol: MEA 64-96-M, Solid Colors.

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9. ASTM E831-06 – Standard Test Method for Linear Thermal Expansion of Solid Thermal Analysis:  $2.96 \times 10^{-5}$ .
10. Coefficient of Linear Thermal Expansion, ASTM D 696-03: 2.3 in/in °F.

C. Wall and Ceiling System Mock-Up Testing for Acryloyl Engineered Polymer Panels:

1. Vacuum Decay Testing on Arcoplast Wall and Ceiling System Mock-up for High Containment Levels BSL-3, BSL-3 Ag, BSL-4:
  - a. Reference – The Public Health Agency of Canada document - Laboratory Biosafety Guidelines: 3<sup>rd</sup> Edition 2004.
  - b. ASME N 510 – Testing of Nuclear Air Treatment Systems.
2. Supplemental Helium Leak Test.
3. Pressure Leak Testing with various MEP interface system for a High Containment Levels BSL-3, BSL-3 Ag, BSL-4:
  - a. The Public Health Agency of Canada – Laboratory Biosafety Guidelines: 3<sup>rd</sup> Edition (2004).
    - 1) Sealed Metal Duct interface with Arcoplast composite panel
    - 2) Electrical Box face plate interface with Arcoplast composite panel
    - 3) Expansion / Contraction joint system interface with Arcoplast composite panel
    - 4) Panel penetration by mechanical fastener
    - 5) Arcoplast Flush Glazed Window Test Report NC-ARC 14810 A-01
    - 6) ISO 9705-Annex B: 1993 (E) Full-scale room test.
4. Engineered polymer panels under guidelines NIH/CDC biological decontamination procedures using:
  - a. Chlorine Dioxide
  - b. Formaldehyde Gas
  - c. Hydrogen Peroxide Vapor
5. Pull-Out Strengths of mechanical fasteners test for fixing and mounting of fitments.

2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard acrylic finishing accessories designed to provide airtight, leak proof and gas tight seal available in thickness from .060" to 1.250 in various sizes and may be installed in wall or ceiling panels.
1. Acrylic Finishing Accessories include the following:
    - a. Grommets
    - b. Face Plates

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- c. Device Trim Plates
  - d. Fire Outlet Boxes
  - e. Slip Connections
  - f. Access Doors
  - g. Escutcheons
  - h. Cabinets
2. Acrylic finishing accessories are labeled as combustible and classified by UL as slow burning plastic. Protect material from flames and high heat sources.
    - a. Flame Spread: 140 per 3mm thickness – ASTM E 84
    - b. Smoke Density: 10.3% - ASTM D 2843
    - c. Self-Ignition temperature: 910F (1.5mm) thickness – ASTM D 1929
- B. Wall and Ceiling Panel Accessories:
1. Splines: Aluminum spline for panel joints or seams.
  2. Battens: Solid engineered polymer resin and filler matrix, same color as composite panels.
  3. Wall Base:
    - a. Solid, engineered polymer resin and filler matrix, same color as composite panels.
    - b. Surface mounted galvanized termination strip.
    - c. Surface mounted stainless steel termination strip.
  4. Attachment Screws: Coated steel or stainless steel screws of length and type as determined by manufacturer to support composite panels.
  5. Adhesive: Structural Adhesive, acrylic base A-2020 – white.
  6. Tape Adhesive: 3M – VHB #4959 - thickness 120 mils x 1/2" (12.5mm) width.
  7. Finishing Compound Edge Tape – 3M - # 335 Pink – Polyester/Rubber 1.6 mils x 3/4" (19mm) width.
  8. Finishing Compound: Arcoplast Sealant and Finishing Compound A-1010 Bio-Seal.
    - a. Description: A two-component, 2:1 mix, non-sag, non-porous, non-yellowing, high-gloss, odor-free, solvent-free structural adhesive.
    - b. Solids: 100 percent.
    - c. Color: Match panel color.
    - d. FDA Approved: Determination of Extractives Residue according to US FDA 21 CFR 177.2600 Arcoplast finishing compound/sealant.
    - e. NSF Approved: Registration #148103.

## PART 3 - EXECUTION

### 3.1 TRAINING AND CERTIFICATION

- A. Only manufacturer trained and certified specialty applicators shall be considered for the

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construction of High Containment Environments as well as BSL-3, BSL-3Ag, and BSL-4 facilities.

1. Minimum Applicator requirements:
  - a. Minimum 2 years' experience in construction of High Containment facilities.
  - b. Familiar with construction guidelines pertaining to Bio-Safety in Microbiological and Biomedical Laboratories established by NIH (National Institute of Health), CDC (Center of Disease Control, NAID (National Institute of Allergy and Infectious Disease).
  - c. Accredited by manufacturer on application of Acryloyl engineered polymer panels for high containment establishments.
  - d. US Department of Labor Occupational Safety and Administration (OSHA).
    - 1) OSHA Standard 29CFR1926 - Safety and Health Regulation for Construction.

### 3.2 EXAMINATION

- A. Examine areas to receive composite wall and ceiling panels. Notify Architect of conditions that would adversely affect installation or subsequent use.
- B. Ensure other work to be performed behind composite panels is complete before starting installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Substrate compatibility and surface adhesion for acryloyl engineered polymer panel materials is critical for performance capable of meeting BSL-3 Ag compliance.
  1. Install composite wall and ceiling panels, accessories, and finish accessories in accordance with manufacturer's written instructions.
  2. When substrate compatibility and surface adhesion is doubtful, conduct physical bond test to determine best surface preparation, adhesive primer, and adhesive product to use and submit recommendations to owner/contractor for approval.
- B. Gauge and thicknesses of all steel studs used in framing support for partition walls must be sized to meet the required use and purpose.
  1. Wall deflections:
    - a. Zero deformation under room pressure.
    - b. 1:360 deflection under design pressure.
  2. Ceiling deflection:

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- a. Zero deformation under room pressure.
  - b. 1:300 maximum allowable deflection of the ceiling panels under total dead and live loads.
- C. All partition and system walls shall be able to support the load of wall mounted fire extinguishers and all wall mounted fitments that have been specified.
- D. The construction of all wall types must allow for mounting of hose reels, fire extinguishers, manual call points, alarm bells, eye wash and any other wall-mounted equipment & fitment.
- E. Fixing and mounting of fitments, fixtures, and fittings, shall not compromise the air-tightness and structural integrity of the system wall panels.
- F. Lay out panels to minimize joints and to provide balanced borders at room perimeter. Use full and uncut panels where possible.
- G. Field cut panels as necessary in accordance with manufacturer's instructions.
- H. Apply mastic or tape adhesive to furring, steel studs, or existing substrate in accordance with manufacturer's instructions.
- I. Screw panels into galvanized steel studs with attachment screws below floor base line and above ceiling line to hide exposed fasteners.
- J. Install panels plumb, level, square, and in proper alignment.
- K. Cover panel joints with finishing compound for flush joints.
- L. Finishing Compound: Clean floor, walls, and ceiling areas thoroughly, seal and quarantine area prior to application. Prepare surfaces and apply finishing compound in accordance with manufacturer's instructions.
- M. Finish wall-to-wall and wall-to-ceiling junctions with 1/2-inch radius joints using finishing compound.
- N. Wall Base: Finish wall-to-floor junctions with 1/2-inch radius joints using finishing compound prior to installing wall base before application of floor finish. Set in mastic in accordance with mastic manufacturer's instructions.
- O. Seamless Floor Application: Sand panels lightly to remove gloss from surface finish ensuring proper bond. If termination bars/strips are to be used for wall-to-floor base termination, install the bars/strips with VHB tape and avoid mechanical fasteners.
- P. Sealants: Apply sealants in accordance with sealant manufacturer's instructions and shop drawings.
  1. Seal joints, openings, and penetrations in accordance with manufacturer's

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instructions and shop drawings.

- Q. Apply Arcoplast finishing compound over countersunk fasteners and penetrations in accordance with manufacturer's instructions.
- R. Repair minor damages to composite panel finish in accordance with manufacturer's instructions and as approved by Architect.
- S. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.
- T. Primary wall and ceiling panel system shall be installed and sealed per manufacturers written instructions to comply with project requirements and testing; including but not limited to the following:
  - 1. Rooms tested for positive/negative pressure.
  - 2. Room sterilized for micro-bacterial decontamination without risk of transfer of fumes to adjoining spaces.
  - 3. Rooms sealed to prevent cross-contamination between rooms and service corridors.

### 3.4 CLEANING

- A. Remove temporary protective film at doorways, windows, equipment, and accessories.
- B. Clean composite panels promptly after installation in accordance with manufacturer's instructions.
- C. Do not use harsh cleaning materials or methods that would damage finish.

### 3.5 PROTECTION

- A. Protect installed composite wall and ceiling panels from damage.
- B. Allow 24 hours curing time before pressure wash down sanitation procedures.

### 3.6 COMMISSIONING

- A. Room commissioning shall be performed by third party Commissioning Agency.
- B. Manufacturer shall have representative present at time of Commissioning Testing.
  - 1. Provide manufacturer 10 day notice prior to the scheduled testing.

END OF SECTION 06 83 15



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## **SECTION 07 21 00 - THERMAL INSULATION**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Mineral-wool blanket insulation.
  - 2. Spray polyurethane foam insulation.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Fire Resistance Ratings: As determined by testing identical products according to ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Combustion Characteristics: As determined by testing identical products according to ASTM E 136 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 PRODUCTS

### 2.1 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fibrex Insulations Inc.
  - 2. Owens Corning.
  - 3. Roxul Inc.
  - 4. Thermafiber.
  - 5. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

### 2.2 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. BaySystems NorthAmerica, LLC.
    - c. Dow Chemical Company (The).
    - d. ERSystems, Inc.

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- e. Gaco Western Inc.
  - f. Henry Company.
  - g. NCFI; Division of Barnhardt Mfg. Co.
  - h. SWD Urethane Company.
  - i. Volatile Free, Inc.
  - j. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
2. Minimum density of 1.5 lb/cu. ft. thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

#### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

#### 3.3 PROTECTION

- A. 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.

END OF SECTION 07 21 00

THERMAL INSULATION

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## **SECTION 07 25 00 - WEATHER BARRIERS**

### **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. Building wrap.

- B. Related Requirements:

- 1. Section 06 16 00 "Sheathing" for sheathing joint and penetration treatment.

#### 1.3 ACTION SUBMITTALS

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

- 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier, from ICC-ES.

### **PART 2 PRODUCTS**

#### 2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

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

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- a. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
  - b. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
  3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
  4. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

## 2.2 UNDERLAYMENT

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

## PART 3 EXECUTION

### 3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.
- D. Building Wrap: Comply with manufacturer's written instructions.
1. Seal seams, edges, fasteners, and penetrations with tape.
  2. Extend into jambs of openings and seal corners with tape.

END OF SECTION 07 25 00

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## **SECTION 07 41 16 - STANDING-SEAM METAL ROOF PANELS**

### **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 standing-seam metal roof panels.

#### 1.3 PREINSTALLATION MEETINGS

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

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.



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1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

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## 1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 10 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

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## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing 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.

### 2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AEP Span; a BlueScope Steel company.
    - b. Berridge Manufacturing Company.
    - c. CENTRIA Architectural Systems.
    - d. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Nominal Thickness: 0.034 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.

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- 1) Color: Shall match existing roofing panels.
  
3. Clips: One-piece fixed to accommodate thermal movement.
  - a. Material: 0.064-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
  
4. Joint Type: As standard with manufacturer.
5. Panel Coverage: Match existing.
6. Panel Height: Match existing.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

## 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
  
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

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- D. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.
- F. Snow Guards: Pad type guard mounted to standing seams – one per seam; Basis of design Alpine model #33 or equal.

## 2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

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4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Indicate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
  - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

## 2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Exterior Facings and Accessories:
  1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. 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. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  4. Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes 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.
  5. FEVE Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish containing 100 percent fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

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6. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

D. Interior Facings:

1. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
2. Acrylic or Polyester Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
  2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

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### 3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.
- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

### 3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.



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- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  5. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

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### 3.5 ERECTION TOLERANCES

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

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

### 3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 16

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## **SECTION 07 42 13 – FORMED METAL PANELS**

### **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. Concealed-fastener, lap-seam metal wall panels.
  - 2. Metal Soffit Panels

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
  - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

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- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

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## 1.10 WARRANTY

- A. **Special Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. **Special Warranty on Panel Finishes:** Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - 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. **Structural Performance:** Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: As indicated on Drawings.
  2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. **Thermal Movements:** Allow for thermal movements from ambient and surface temperature changes by preventing 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 (Range): 120 deg F, ambient; 180 deg F, material surfaces.

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## 2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Berridge Manufacturing Company. "M" Panel
    - b. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Nominal Thickness: 0.034 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: Zinc Grey.

## 2.3 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Soffit Panels to match existing metal soffit panels – Basis of Design: Dimensional Metals Inc. FP10.
  - 1. Aluminum Sheet: Coil-coated sheet, **ASTM B 209**, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
    - a. Thickness: **0.040 inch**.
    - b. Width: Match existing.
    - c. Surface: Smooth, flat finish.
    - d. Exterior Finish: Three-coat fluoropolymer.
    - e. Color: As selected by Architect from manufacturer's full range.

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## 2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Sub-framing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

## 2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements



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demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if

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they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

#### 3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise

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indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

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- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

### 3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

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- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

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## **SECTION 07 62 00 - 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 steep-slope roof sheet metal fabrications.

B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
- 2. Section 07 42 13 "Formed Metal Panels" for metal wall and soffit panels.

#### **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 type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

- 1. Include plans, elevations, sections, and attachment details.
- 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

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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 edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
8. Include details of special conditions.
9. Include details of connections to adjoining work.

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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. 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.

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.

1.8 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. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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- 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 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies 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" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. 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. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.



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- B. **Metallic-Coated Steel Sheet:** Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
1. Surface: Smooth, flat.
  2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  3. Color: Zinc Grey to match existing.
  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. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: 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 according to written recommendations of underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: 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[ **or manufactured item**] unless otherwise indicated.
- 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.

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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.
  - C. 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 wide and 1/8 inch thick.
  - D. Elastomeric Sealant: ASTM C 920, elastomeric [polyurethane] [polysulfide] [silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
  - E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
  - F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
  - G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
  - H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- 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.

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- 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. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. 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.
- E. 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.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
  - 1. Gutter Profile: Style F according to cited sheet metal standard, match existing.
  - 2. Expansion Joints: Lap type.
  - 3. Gutters with Girth 21 to 25 Inches: Fabricate from the following materials:
    - a. Galvanized Steel: 0.034 inch thick.

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- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
  - 1. Fabricated Hanger Style: Fig 1-35B according to SMACNA's "Architectural Sheet Metal Manual."
  - 2. Fabricate from the following materials:
    - a. Galvanized Steel: 0.022 inch.

## 2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.022 inch thick.
- B. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.022 inch thick.
- C. Counterflashing: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.022 inch thick.
- D. Flashing Receivers: Fabricate from the following materials:
  - 1. Galvanized Steel: 0.022 inch thick.

## 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.

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### 3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  - 5. Torch cutting of sheet metal flashing and trim is not permitted.
  - 6. 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 uncoated-aluminum and 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.

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- 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 substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- 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.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

### 3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections to match existing. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
  - 1. Fasten gutter spacers to front and back of gutter.
  - 2. Anchor and loosely lock back edge of gutter to continuous cleat.
  - 3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
  - 4. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
  - 5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.

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1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

### 3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to 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.

### 3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

### 3.7 CLEANING AND PROTECTION

- 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.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. 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.

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## **SECTION 07 92 00 - JOINT SEALANTS**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. JS-1 - Urethane joint sealants.
  - 2. JS-2 – Non-staining Silicone
  - 3. JS-3 - Siliconized Acrylic Latex
  - 4. JS-4 - Latex-Base Elastomeric

#### **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 joint-sealant product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

#### **1.5 INFORMATIONAL SUBMITTALS**

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

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## 1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An authorized representative who is trained and approved by manufacturer.
- B. **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.
- C. A sealant mock-up shall be constructed for approval of the PO and Pest Management Representative. The mock-up shall include all typical conditions and materials, and shall remain in place as a basis of comparison and approval of the final installation.
- D. Non-Lab column in Sealant Table lists requirements for spaces that are within the containment area but outside of the laboratories and anterooms.

## 1.7 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.
  - 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.
- B. Confirm compatibility between sealants, and between sealants and the materials to which they will be applied.

## 1.8 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:** Five years from date of Substantial Completion.

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

## PART 2 PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
1. Architectural sealants shall have a VOC content of 250 g/L or less.
  2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
  3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
1. All BSL-3 and ABSL-3 sealants shall be color White.
  2. Use aluminum finish silicone sealant when sealing stainless steel in cage washers, tunnel washers, rack washers and other stainless steel equipment, fixtures and assemblies.

### 2.2 MANUFACTURERS

### 2.3 JS-1.2 ARCHITECTURAL URETHANE JOINT SEALANTS

1. Bostik Inc
2. Hilti, Inc.

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3. Pecora Corporation
4. Sherwin-Williams
5. Sika
6. Specified Technologies
7. Tremco
8. W.R. meadows

- B. Urethane, M, NS, 50, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Use NT.
- C. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT
- D. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.

#### 2.4 JS-2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.
- B. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
- C. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- D. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- a. Use mildew resistant silicone sealant when sealing toilets, sink faucets and other plumbing fixtures, and in areas subject to standing water and dampness

#### 2.5 JS-3 SILICONIZED ACRYLIC LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
1. Note: Latex plus silicone is not an acceptable product
  2. Products: Subject to compliance with requirements, provide the following or equal:

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a. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk

- B. Non-halogenated latex-based caulk designed to provide passive smoke and fire protection in construction joints; ASTM C 920.
  - 1. Restores sound attenuation properties to sound-rated ceilings and partitions.
  - 2. Refer to spec section 07 84 43 – Joint Firestopping for additional requirements.

2.6 JS-4 LATEX JOINT SEALANTS

- A. JS-4.2 Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330. As approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 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.

2.8 MISCELLANEOUS MATERIALS

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

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## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. For ABSL-2, ABSL-3 and BSL-3 projects, all joints, gaps, seams, penetrations and voids in the laboratory perimeter enclosure (including floor, ceiling, walls, doors, window) shall be completely sealed, forming a continuous monolithic and impermeable infiltration barrier. All fixtures, furniture and devices (including fixed equipment, casework, shelving systems, mechanical and electrical devices) shall be completely sealed, including, but not limited to, all conditions listed in the Sealant Table.
- D. Penetrations in rated assemblies shall be appropriately UL rated and approved by the Fire Marshall. Finish sealants, listed in the Sealant Table, shall be in addition to, and not a substitute for, rated sealants.

### **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. Glass.

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- 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.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. **Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.**
- E. **Install sealants using proven techniques that comply with the following and at the same time backings are installed:**
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. **Tooling of 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. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  - 2. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.

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- G. Sealant of plates, escutcheons and similar items shall be bedded with a bead at the perimeter.
- H. Sealant must be full coverage, without gaps or voids. Sealant must be applied in an even and professional manner, without drips or excessive material. Previously sealed items shall be cleaned of old sealant and properly prepared for resealing. Sealant cannot adversely impact the operation of sprinklers or other devices. Sealant shall be installed following manufacturer's recommended methods and details.
- I. Porous insulation shall not extend through BSL-3, ABSL-3 and ABSL-2 perimeter walls, but shall be sealed at walls.

### 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. JS-1 Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Sealant: Urethane T
  - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. JS-1 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 between metal panels.
    - c. Joints between different materials listed above.
    - d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
    - e. Control and expansion joints in ceilings and other overhead surfaces.
    - f. Other joints as indicated on Drawings.

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2. Joint Sealant: Urethane 50 NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. JS-1 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces. Refer to Sealant Table below for additional information.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
    - c. All vertical interior urethane resisting joints.
  2. Joint Sealant: Urethane, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. JS-2 Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces. Refer to Sealant Table below for additional information.
1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Seal all interior window frames (including gasketed areas)
    - c. Hot water line insulation shall be wrapped in aluminum and the seams and ends of insulation sealed.
  2. Joint Sealant: 100% Silicone, mildew resistant.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. JS-3 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement. Refer to Sealant Table below for additional information.
1. Joint Locations:
    - a. All interior joints not otherwise indicated.
    - b. Seal all counter tops where they contact dissimilar materials
    - c. Seal around all wall guards, bumpers and rails
    - d. Seal all corner guards
    - e. Seal the perimeter of all suspended acoustical or FRP ceiling frames at the wall juncture
    - f. Seal around wall and ceiling, surface-mounted cover plates and surface-mounted mounting plates
    - g. Seal all duct work that penetrates the wall envelope.
    - h. Seal all diffusers/grill joints in hard ceilings.
    - i. Seal plumbing to surface
    - j. Seal all plumbing escutcheon and cover plates at the wall and pipe junctions
    - k. Seal all sprinkler collars
    - l. Seal all piping that penetrates the wall envelope.

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- m. Seal joints between ceiling and light fixtures in hard ceilings
    - n. Seal perimeter of device boxes to adjacent drywall/CMU. Wire within conduit shall be sealed also.
    - o. Conduit and raceway shall be sealed tight to wall or ceiling surfaces.
  2. Joint Sealant: Siliconized Acrylic latex ASTM C834
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. JS-4 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement. Refer to Sealant Table below for additional information.
  1. Joint Locations:
    - a. Seal all penetrations on the top and bottom of slab.
    - b. Seal space in wall penetrations, including inside sleeves, collars, and surrounding construction.
  2. Joint Sealant: Non-Halogenated Latex-Base Elastomeric
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. JS-4 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
    - d. Joints on underside of plant-precast structural concrete.
    - e. All vertical interior urethane resisting joints.
  2. Joint Sealant: Urethane, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. JS-4 Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  1. Joint Locations:
    - a. All interior joints not otherwise indicated.
  2. Joint Sealant: Acrylic latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

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3.7 SEALANT TABLE

Group	Description	Non-Lab Sealants	BSL-2 Sealants	BSL-3, ABSL-3 and ABSL-2 Sealants	Comments
Doors	Seal all penetrations in doors	N/S	N/S	JS-2	
	Seal all door hinge plates (not at pin) to include piano hinges	N/S	N/S	JS-2	
	Seal door frame and wall board interface	JS-3	JS-3	JS-1	
	Seal view panel frames (around glass whether or not gasketed)	N/S	N/S	JS-2	Interior and exterior sides
	Seal around lock sets	N/S	N/S	JS-2	Seal between escutcheon plates and door
	Seal around all sides of latch boxes installed within frames	N/S	N/S	JS-2	
	Seal door thresholds to the floor and around the threshold	JS-1	JS-1	JS-1	
	Seal door protection plates and tapered door guards to doors	N/S	N/S	JS-2	
	Seal gaps around door magnet latch at head of door and frame	N/S	N/S	JS-3	
Cabinetry/ Shelving	Seal openings in the base of tables where the support feet mount to the table	N/S	JS-3	JS-2	
	Seal openings in table legs where the support feet mount to the floor	N/S	JS-3	JS-2	
	Seal all cabinets where they contact dissimilar materials and where they contact one another	N/S	JS-1 or 3**	JS-1 or 3**	Cabinets need to be closed boxes. Seal all voids and joints in cabinets construction. Seal all removable panels.
	Seal all counter tops where they contact with dissimilar material	N/S	JS-1 or 3**	JS-1 or 3**	Depends on finish
	Seal around all shelf support brackets where they contact the shelves and are mounted to the walls	N/S	N/S	JS-3	This is for specialty shelving used in laboratories
	Seal tops and bottoms of all wall mounted shelving brackets	N/S	JS-3	JS-3	A plug shall be sealed
	Seal all gaps and openings in racks	N/S	N/S	JS-2	For ABSL-3 equipment, typically stainless steel racks in aquatic rooms
	Seal covers between shelf standards	N/S	JS-1 or 3**	JS-1 or 3**	
	Seal peninsula shelving support at countertop and at ceiling	N/S	JS-1 or 2**	JS-1 or 2**	
Group	Description	Non-Lab Sealants	BSL-2 Sealants	BSL-3, ABSL-3 and ABSL-2 Sealants	Comments

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Walls/ Floors/ Ceilings	Seal around all wall guards, bumpers, and rails	N/S	JS-3	JS-3	Brackets/fasteners shall be installed right to wall.
	Seal all penetrations on the top and bottom of slab	N/S	JS-4	JS-4	To include but not limited to HVAC, plumbing and electrical penetrations, and like penetrations through interstitial space.
	Seal around all corner guards	N/S	JS-3	JS-3	Brackets/fasteners shall be installed right to wall.
	Seal around all door bumpers	N/S	N/S	JS-3	Brackets/fasteners shall be installed right to wall.
	Seal top of trim strip and sheet flooring at wall	N/S	N/S	JS-3	
	Seal top of cove base	N/S	JS-1	JS-1	
	Seal bottom of cove base	N/S	JS-1	N/A	Integral base required in BSL-3, ABSL-3 and ABSL-2
	Seal all ceiling access panels (whetherr or not 100% gasketed)	N/S	N/S	JS-3	
	Seall the perimeter of all suspended acoustical or FRP ceiling frames at the wall juncture	N/S	JS-3	JS-3	
	Seal around wall and ceiling, surface-mounted cover plates and surface-mounted mounting plates	N/S	JS-1 or 3**	JS-1 or 3**	This applies to exposed mounted brackets. The use of sealant at these brackets is as follows: 1) If the bracket or wall mounted fixture is easily removable, then sealant is not required, 2) If the brackets are permanently affixed to wall, then joints shall be sealed. Each bracket shall be examind for requirement of sealant on a case by case basis.
	Seal all around floor surface-mounted mounting plates	N/S	JS-1	JS-1	This applies to exposed mounted brackets. The use of sealant at these brackets is as follows: 1) If the bracket or wall mounted fixture is easily removable, then seal is not required, 2) If the brackets are permanently affixed to wall, then joints shall be sealed. Each bracket shall be examind for requirement of seal on a case by case basis.
	Seal all around floor surface-mounted cover plates	N/S	JS-1	JS-1	
<b>Group</b>	<b>Description</b>	<b>Non-Lab Sealants</b>	<b>BSL-2 Sealants</b>	<b>BSL-3, ABSL-3 and ABSL-2 Sealants</b>	<b>Comments</b>
Walls/ Floors/ Ceilings	Seal and cap the tops of all CMU walls	N/A	N/A	N/S	Animal Research Facilities' CMU walls shall be capped with cap block. Seal penetrations of cap block with JS-3.
	Seal control joints in walls	N/S	JS-1	JS-1	

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	Seal control joints in ceilings	N/S	JS-1	JS-1	
	Seal control joints in floors	JS-1	JS-1	JS-1	Not visible to room - beneath floor. Use sealants recommended by flooring manufacturer under resinous floors.
	Seal joints between walls of dissimilar materials	JS-3**	JS-3**	JS-3 **	
	Seal space in wall penetrations, including inside sleeves, collars, and surrounding construction	JS-4	JS-4	JS-4	Where stuff mineral wool is applied, use fire stop and spray over with JS-4.
HVAC	Seal all duct work that penetrates the wall envelope	N/S	JS-3	JS-3	
	Seal all diffusers/grill joints in hard ceilings	N/S	JS-3	JS-3	
Plumbing	Hot water line insulation shall be wrapped in aluminum and the seams and ends of insulation sealed	N/S	JS-2	JS-2	This applies for steam lines (e.g., autoclaves)
	Seal at vacuum pass through	N/S	JS-3	JS-3	
	Seal all cracks in foam rubber water line insulation	N/S	JS-3	JS-3	
	Seal all flat escutcheon plates and support standoff brackets for animal water systems shall be sealed all around	N/S	JS-3	JS-3	
	Seal plumbing to surface	N/S	JS-3	JS-3	
	Seal all plumbing escutcheon and cover plates at the wall and pipe junctions	N/S	JS-3	JS-3	
	Seal around sprinkler collars	N/S	JS-3	JS-3	Seal inside and outside of collar. Confirm that sealant does not interfere with sprinkler operation.
	Seal all piping that penetrates the wall envelope	N/S	JS-3	JS-3	
Electrical	Conduit and raceway shall be sealed tight to wall or ceiling surfaces	N/S	JS-3	JS-3	Sealant is required on both sides of surface mounted conduit and raceway
	Conduit and raceway shall be sealed tight to wall or ceiling surfaces	N/S	JS-3	JS-3	Sealant is required on both sides of surface mounted conduit and raceway.
Group	Description	Non-Lab Sealants	BSL-2 Sealants	BSL-3, ABSL-3 and ABSL-2 Sealants	Comments

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Electrical	Seal perimeter of device boxes to adjacent drywall/CMU. Wire within conduit shall be sealed also.	N/S	*N/S	JS-2	Applicable for ALL power, communications, signal and control applications within ABSL-3 and BSL-3 laboratory facilities: All device boxes shall be cast type with external hub. Where boxes and conduits are recessed mounted, the box to the adjacent wall, ceiling or floor surface shall be sealed. All wiring shall be provided in either threaded rigid galvanized steel (RGS), intermediate metal conduit (IMC - only when recessed). Gasketed device cover plates shall be used, with an additional continuous bead of silicone caulk between the device box cover plate and the adjacent wall, ceiling or floor surface. Where device boxes and conduits are surface mounted, and where the device box meets the wall, ceiling, or floor surface, a continuous bead of silicone sealant shall be provided. Non-recessed conduits are then required to be threaded RGS on minimum 19 mm (3/4 in) standoffs, or if also surface mounted, both sides of the conduit shall be sealed to adjacent surfaces with silicone sealant. Once wiring is installed, the wiring shall be surrounded by a one inch barrier of silicone caulking around the conductors within the device box hub. This provides for a gas-tight electrical installation allowing decontamination of the BL3 space, and prevents vermin harborage in the BL3 space, and prevents vermin harborage in and transmission through the electrical distribution systems.
Equipment	Seal all fixed equipment that is within 38 mm or less from ceiling	N/S	JS-1	JS-1	
	All sinks shall be sealed if they contact other surfaces, including mounting and support brackets.	N/S	JS-1	JS-1	
	Large gaps, behind the back splash shall be filled in with foam cord and sealed in place	N/S	JS-3	JS-3	
	Seal all gaps and openings in secured/fixed equipment	N/S	N/S	JS-3	May hinder function of equipment - Review on a case-by-case basis.
Group	Description	Non-Lab Sealants	BSL-2 Sealants	BSL-3, ABSL-3 and ABSL-2 Sealants	Comments

JOINT SEALANTS

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Equipment	Seal gaps that exist between stainless steel sheet metal in all cage washers	N/S	JS-2	JS-2	
	Seal gaps that exist between stainless steel sheet metal in all tunnels washers	N/S	JS-2	JS-2	
	Seal gaps that exist between stainless steel sheet metal in all rack wash equipment	N/S	JS-2	JS-2	
	Seal around frames and holes inside of fire extinguishers boxes	N/S	JS-2	JS-2	Some doors have hollow channel in access doors. Seal access door frame channels and glass cover where no clips are present.
	Seal around the metal rod hangers used to hold the exhaust hoods where they penetrate the drop ceiling	N/S	JS-1 or 2**	JS-1 or 2**	
	Seal wall mounted heating/air conditioner unit casework and utility penetrations	N/S	JS-3	JS-3	
	Seal floor mounted equipment supports, legs and standoff supports	N/S	JS-1	JS-1	
Fixtures	Seal stainless steel equipment at all joints and gaps	N/S	JS-2	JS-2	
	Seal toilet mounted to surface	JS-2	JS-2	JS-2	
	Seal sink faucet mounted to surface	JS-2	JS-2	JS-2	
	Seal wall hung equipment at surface attachment	N/S	JS-2	JS-2	

END OF SECTION 07 92 00



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## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes hollow-metal work.
- B. Related Requirements:
  - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

#### **1.3 COORDINATION**

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.

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- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door Products; an Assa Abloy Group company.
  - 2. Curries Company; an Assa Abloy Group company.
  - 3. Republic Doors and Frames.
  - 4. Steelcraft; an Ingersoll-Rand company.
  - 5. West Central Manufacturing
  - 6. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

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## 2.2 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. All interior locations.
  - 1. Physical Performance: Level B according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Manufacturer's standard polyisocyanurate core at manufacturer's discretion.
  - 3. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Construction: Full profile welded.
  - 4. Exposed Finish: Prime.

## 2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

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- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

## 2.4 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
  - 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
  - 4. Top Edge Closures: Flush edge closures of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
  - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  - 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

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4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - b. Compression Type: Not less than two anchors in each frame.
  6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
  1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

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## 2.5 STEEL FINISHES

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

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

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**END OF SECTION 08 11 13**



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## **SECTION 08 16 13 – FIBERGLASS-REINFORCED POLYMER (FRP) DOORS**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 08 11 13 "Hollow Metal Doors and Frames".
- C. Section 08 71 00 "Door Hardware".

#### 1.2 QUALITY ASSURANCE

- A. Construction: Verify that FRP doors and frames are manufactured utilizing pultruded fiberglass components.
- B. Resins: Resins shall comply with USDA and FDA standards for incidental food contact
- C. Flame Spread Rating: Flame retardant structural shapes meet the minimum flame spread rating less than or equal to 25 when tested according to ASTM E84.
- D. Physical Endurance: FRP Doors and frames to successfully complete 1,000,000 cycles Grade A swing test in compliance with ANSI/SDI A250.4-2011.
- E. Impact Strength: FRP doors 10.32 foot-pounds per inch, ASTM D-256.
- F. Tensile Strength:
  - 1. FRP doors 12,000 psi, ASTM D-638.
  - 2. FRP frames 30,000 psi, ASTM D-638.
- G. Flexural Strength: FRP doors and frames 25,000 psi, ASTM D-790.
- H. Compressive Strength:
  - 1. FRP doors 18,000 psi, ASTM D-695.
  - 2. FRP frames 30,000 psi, ASTM D-695.
- I. Water Absorption: FRP doors and frames .27%, ASTM D-570.

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- J. Hardware Reinforcements: FRP doors and frames fabricated with a minimum screw holding strength of 1,000 lbs. Tested with a #12 x 1-1/4" hinge screw.
- K. Warranty: Life of the initial installation against failure due to corrosion. Additionally, lifetime warranty against failure due to materials and workmanship from date of substantial completion.

### 1.3 SUBMITTALS

- A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details and finishes.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver doors and frames crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage and notify shipper and supplier if damage exists. Minor damages may be repaired provided refinished items match new work and are acceptable to the Architect. Remove and replace damaged items that cannot be repaired as directed.
- C. Store doors and frames at building site under cover. Avoid using non-vented plastic or canvas covers that could create a humidity chamber.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. FRP Architectural Doors Inc.
  - 2. Weiland
  - 3. Special-Lite, Inc.
  - 4. Others submitted and approved by Architect prior to bid submittal.
- B. Interior Doors: Provide doors complying with requirements indicated below:
  - 1. CF34 (Heavy Duty).
  - 2. Doors to have at least two internal full height vertical FRP stiffeners for warp resistance.
  - 3. Polystyrene foam core standard.
- C. Vision Lite Systems: Lite cutout shall be built-in during door assembly, utilizing FRP tubing.

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## 2.2 FABRICATION

- A. General: Fabricate fiberglass door and frame units to be rigid and free from defects including warp and buckle.
- B. Core Construction: Manufacturer's standard core construction that complies with the following:
  - 1. Expanded polystyrene or polyurethane foam core.
  - 2. Fire resistant mineral core.
- C. Stiles and Rails: Fabricate doors using FRP pultrusions.
- D. Door Faces: Fiberglass face skins shall be fused to the stile and rail assembly, including the vertical stiffeners and core material, utilizing polyurethane adhesive.
- E. Clearances: Not more than 1/8" at jambs and heads. Not more than 1/4" between pairs of doors. Not more than 3/4" at bottom unless indicated otherwise.
- F. Door Edges: Lock stile to be factory beveled 3 degrees, standard.
- G. Tolerances: Maximum diagonal distortion 1/8" measured with straight edge, corner-to-corner.
- H. Hardware Reinforcement: Fabricate all hardware reinforcements using FRP pultrusions.
- I. Exposed Fasteners: Unless otherwise indicated, provide stainless steel, countersunk flat or oval heads for exposed screws and bolts.
- J. Hardware Preparations: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier.
- K. Hardware Locations: Locate hardware as indicated on shop drawings or, if not indicated, according to manufacturer's standard locations.
- L. Glazing Stops: Two-piece PVC lite kits.
  - 1. Provide screw-applied, removable, glazing stops on inside of opening, louvers, and other panels in doors.
  - 2. Glass to be supplied and installed under section 08800, unless stated otherwise.

## 2.3 FINISHES

- A. Two-component acrylic urethane topcoat custom color, factory-finished.

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## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install FRP doors, frames, and accessories according to shop drawings, manufacturer's data, and as specified.
- B. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
  - 1. Except for frames located in existing walls, place frames before construction of enclosing walls and ceilings.
  - 2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge locations on hinge jamb and at corresponding heights on strike jamb, utilizing masonry wire anchors.
  - 3. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with stainless steel expansion bolts.
  - 4. For openings 90" or more in height, install an additional anchor at hinge and strike jambs.
- C. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- D. Door Installation: Fit fiberglass doors accurately in frames. Shim as necessary.

END OF SECTION 08 16 13

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**SECTION 08 30 00 – SPECIALTY DOOR SYSTEMS**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Manually operated, compression gasket airtight doors.
- B. Related Sections: The following Sections and Divisions contain requirements that relate to this Section:
  - 1. Section 08710 Door Hardware
  - 2. Division 15 Mechanical
  - 3. Division 16 Electrical

1.3 SUBMITTALS

- A. Shop Drawings: Submit for fabrication and installation of door and track. Include details and elevations of door and hood. Show anchorage and accessory items.
- B. Product Data: Submit manufacturer's data for each type of specialty door listed.
- C. Sample: Submit samples of door and track components as requested by the Engineer/Architect.
- D. Operating and Maintenance Data: Submit information for door and accessories.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver door within a carton or crated to provide protection during transit and job storage.

**PART 2 PRODUCTS**

1.5 TYPE AND MANUFACTURER

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- A. Manufacturer: Subject to compliance with requirements, provide compression pneumatically-inflatable gasketed air-tight doors basis of design PBSC HC-ISD or by approved following manufacturers:
1. Presray Corporation
  2. Protective Door Industries

1.6 COMPRESSION GASKETED AIR TIGHT DOOR

A. Product Description

1. Airtight door with inflatable gasket seal to limit air movement between segregated spaces.

B. Materials

1. Panel and Frame: Construct 304 Stainless Steel Plate. Finish at all inner exposed surfaces to be compatible with Vaporized Hydrogen Peroxide fumigant.
2. Gasket: ASTM D2000 GR DE neoprene compression gasket, 25 duro with fully molded corners. Extruded gaskets and mitered corners are not acceptable.
3. Operating Mechanism – Quick acting lever shall simultaneously actuate all dogs at head, sill and jambs. Door unit shall be provided with a means for adjusting gasket compression in the field.
4. Interlocking Operation: Provide magnetic locks to interface with fumigation (vaporized hydrogen peroxide) equipment and Building EMCS to ensure doors remain closed during fumigation cycle. Airtight doors to fumigation chamber shall be interlocked, preventing more than one door from being opened simultaneously, with exception of emergency access conditions. Magnetic lock and associated accessories to be provided and interfaced with owner-provided security and monitoring system.
5. Door size: As shown on drawings
6. Vision Panel: Per manufacturer standard.
7. Vision Panel: Per manufacturer standard.
8. Provide operation panel each side of door with emergency release, alarm notice, lighted door position notice.

**PART 3 EXECUTION**

1.7 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected.
- B. Verify opening size, dimensions, and tolerances.

1.8 PREPARATION

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- A. Protect surrounding areas and surfaces to prevent damage during the work of this section.

1.9 INSTALLATION

- A. Install specialty doors in accordance with approved shop drawings and manufacturer's recommendations.

1.10 WARRANTIES

- A. Provide one year warranty on all door components.

END OF SECTION 08 30 00



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## **SECTION 08 71 11 – DOOR HARDWARE**

### **PART 1 - GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes finish hardware for the proper operation and control of all doors in the Project. Prior to bidding, notify Architect of any doors that do not have hardware meeting this intention.
- B. Hardware supplier will be responsible to furnish and install hardware on labeled doors to satisfy State and Local Building Codes.
- C. Related Sections include the following:
  - 1. Division 8 Section "Hollow Metal Doors and Frames."
  - 2. Division 8 Section "Fiberglass-Reinforced Polymer Doors."

#### 1.3 SUBMITTALS

- A. Product Data: For each product and material indicated, submit manufacturer's technical product data. Include information necessary to show compliance with requirements, installation instructions and maintenance instructions.
- B. Hardware Schedule: Submit a hardware schedule organized into sets, including the information below. Designations for door numbers and hardware sets shall match those used in the construction documents.
  - 1. Opening Number
  - 2. Door Type and Size
  - 3. Frame Type and Size
  - 4. Frame Anchoring Method
  - 5. Hardware Set
  - 6. Assembly Rating
- C. Hardware Schedule shall be coordinated with the doors, frames and related work to ensure proper size, thickness, hand function and finish of door hardware

#### 1.4 QUALITY ASSURANCE

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- A. **Supplier Qualifications:** A recognized Architectural Finish Hardware Supplier, with warehousing facilities, who has been furnishing hardware in the Project's vicinity for a period of not less than two (2) years. Supplier shall be or employ an experienced Architectural Hardware Consultant (AHC) who is certified by and member of the Door and Hardware Institute. The Architectural hardware Consultant shall be available, at reasonable times during the course of the work, for consultation about Project's hardware requirements, to Owner, Architect and Contractor.
- B. **Fire-Rated Openings:** Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80, No. 101 and local building code requirements. Provide only hardware, which has been tested and listed, by UL, FM or Warnock Hersey for types and sizes of doors required and complies with requirements of door and door frame labels.
- C. **Standards:** Comply with the requirements of the latest edition of the following standards unless indicated otherwise:
  - 1. American National Standards Institute Publications:
    - a. A115 Series – Door and Frame Preparation
    - b. A156 Series – Hardware
  - 2. Builders Hardware Manufacturer's Association Publications:
    - a. 1201 – Auxiliary Hardware
    - b. 1301 – Materials and Finishes
  - 3. Door and Hardware Institute Publications:
    - a. Keying – Procedures, Systems and Nomenclature
    - b. Abbreviations and Symbols
    - c. Hardware for Labeled Fire Doors
    - d. Recommended Locations for Builder's Hardware for Standard and Custom Steel Doors and Frames
    - e. Wood Door Standards W1, W2, WDHS-2, WDHS-3
  - 4. National Fire Protection Association Publications
    - a. NFPA 80 – Standards for Fire Doors and Windows
    - b. NFPA 101 – Life Safety Code
  - 5. International Building Code – 2015 Edition
  - 6. American with Disabilities Act.
- D. **Preinstallation Conference:** Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Inspect and discuss preparatory work performed by other trades.
  - 3. Inspect and discuss electrical roughing-in for electrified door hardware.
  - 4. Review sequence of operation for each type of electrified door hardware.
  - 5. Review required testing, inspecting, and certifying procedures.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package each hardware item in separate containers with all screws, wrenches, installation

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instructions and installation templates. Mark each box with hardware heading and door number according to approved hardware schedule.

- B. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation: Provide a complete packing list showing items, door numbers and hardware headings with each shipment.
- C. Store hardware in shipping cartons above ground and under cover to prevent damage. Provide secure lockup for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable -so that completion of the Work will not be delayed by hardware losses both before and after installation.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with delivery and/or installation when ambient and substrate temperature conditions are outside limits permitted by material manufacturers.

#### 1.7 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

### **PART 2 - PRODUCTS**

#### 2.1 HARDWARE GENERAL

- A. Provide the materials of products indicated by trade names, manufacturer's name, or catalog number. Substitutions will not be permitted except as described in Division 1.
- B. Provide manufacturer's standard products meeting the design intent of this Specification, free of imperfections affecting appearance or serviceability.
  - 1. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.
  - 2. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
  - 3. Furnish screws for installation with each hardware item. Provide Phillips flat head

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- screws except as otherwise indicated or approved. Finish screws exposed under any condition to match hardware finish, or, if exposed in surface of other work, to match finish of such other work as closely as possible. Use machine screws for metal connections and wood screws for connections to wood. Use manufacturer's screws to secure hardware.
4. Provide concealed fasteners for hardware unit with care exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt, head or nut on opposite face is exposed in other work, except where indicated otherwise or where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.
  5. Special Tools: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance and removal and replacement of finish hardware.
- C. Hardware is specified in the hardware schedule by set, type and functions, which have been selected as best meeting the application requirements. Acceptable products for each category are specified in Paragraph 2.5 "Hardware Products".

## 2.2 SPECIAL REQUIREMENTS

- A. General:
1. Where new doors and hardware are scheduled to be installed in existing frames, contractor to coordinate hinge sizes and locations, lockset backsets, strikes, hardware mounting heights, etc with existing frames to ensure new door and hardware fits and functions properly in existing frame.
- B. Hinges:
1. Use heavy weight hinges for all doors.
  2. Provide non-removable pins for all exterior doors and out-swinging corridor doors. Use nonrising pins for all other doors.
  3. Pre-drill pilot holes for hinge fasteners at factory to suit hinge type.
- C. Locksets:
1. Locksets to be grade 1 heavy duty cylindrical or as specified.
- D. Exit Devices:
1. All latchbolts to be deadlatching type.
  2. All touchbars to be stainless steel.
  3. Devices are to incorporate a flush and tapered end cap.
  4. Devices incorporating plastic dogging components will not be allowed.
  5. Provide electrical options as specified.
- E. Closers:
1. Comply with manufacturer's recommendations for unit size based on door size and usage.

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2. Provide parallel arms for all overhead closers, except as otherwise indicated.
3. All closers UL Listed Certified to be in compliance with UBC 7.2 and UL 10C.
4. Closers with Pressure Relief Valves will not be acceptable.
5. Provide any brackets or plates required for proper installation of door closers.

F. Stops

1. Provide heavy duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide overhead stop for interior doors that swing more than opens against equipment, casework, sidelights, and where conditions do not allow wall stop.

G. Thresholds and Gasketing

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
3. Gasketing and astragals on aluminum frames by door manufacturer.

2.3 KEYING

- A. Contractor to turn all cylinders over to MU key shop for keying.

2.4 FINISHES

- A. Standard: Comply with BHMA A156.18
1. All door hardware to be US26D/630 throughout project.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the application units of hardware.
- C. Protect finishes on exposed surfaces from any damage by applying a strippable temporary protective covering before shipping.
- D. BHMA Designations: Comply with base material and finish requirements indicated by BHMA standards.

2.5 HARDWARE PRODUCTS

ITEM	SPECIFIED	APPROVED EQUAL
Hinges	Ives	Stanley
Locksets	Best	Schlage, Sargent
Cylinders	Best	No Substitutions

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Closers	LCN	No Substitutions
Panic Devices	Von Duprin	Sargent, Precision
Flatgoods	Ives	Burns, Rockwood
Stops	Ives	Burns, Rockwood
Overhead Stops	Glynn Johnson	Rixson
Gasket	Zero	NGP, Reese

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and frames with installer present for compliance with the requirements, for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine rough-in for electrical source power to verify actual locations of wiring connections before electrified door hardware installation.
- C. Notify Architect of any discrepancies or conflicts between the door schedule, door types, frame types, drawings, scheduled hardware and built condition.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Steel Frames: Comply with ANSI/DHI A115 Series
- B. Wood Doors: Comply with ANSI/DHI A115-W Series.

#### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated in the following applicable publications, or as required to comply with governing regulations:
  1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames."
  3. Wood Doors: DHI WDHS.2 "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to complete with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage and reinstallation of sur-

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face protective trim units to with finishing work. Do not install surface mounted items until finishes have been completed on substrates involved.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in written report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating items of door hardware and each door to ensure proper operation of function of every unit. Replace units that cannot be adjusted to operate as intended and/or required. Adjust door control devices to compensation for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper finish, and provide final protection and maintain condition that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SETS



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**HARDWARE SET: 1**

**DOOR NUMBER:**

151B

**EACH TO HAVE:**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	DELAYED PANIC HARDWARE	CX98-NL-OP-110MD-CON 24 VDC	630	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	CYLINDER	1E74	626	BES
1	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR BOTTOM	365AA	AA	ZER
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR CONTACT	7764	628	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATION: PULL SIDE - DOOR NORMALLY CLOSED AND LOCKED, NO ENTRY. PUSH SIDE - ALARM WILL SOUND WHEN PUSH PAD IS DEPRESSED, THE DEVICE WILL PREVENT EGRESS FOR 15 SECONDS OR LESS. DEVICE WILL DISARM IMMEDIATELY UPON FIRE ALARM.

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**HARDWARE SET: 2**

**DOOR NUMBER:**

146

**EACH TO HAVE:**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	630	IVE
1	EA	PUSH/PULL LATCH	HL6 9070 2 3/4" A	630	SCH
1	EA	CYLINDER	1E74	626	BES
1	EA	MAGNETIC LOCK	M450P 12/24 VDC	628	SCE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS (PREP/NOTCH FOR HARDWARE AS REQUIRED)	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	MOUNTING BRACKET	870SPB		ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
2	EA	INDICATOR LIGHT	7201XL2-HWR	630	DOR
1	EA	EMER RELEASE BUTTON	CB401-B	630	SDC
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1			CARD READER - WORK OF DIVISION 28		

OPERATION: DOOR NORMALLY CLOSED AND UNLOCKED. OPENING DOOR LOCKS OPPOSING DOORS FROM BOTH SIDES UNTIL DOOR CLOSES. OPENING OPPOSING DOORS LOCKS THIS DOOR FROM BOTH SIDES UNTIL OPPOSING DOOR CLOSES. INDICATOR LIGHTS SHOW WHEN DOOR IS LOCKED OR UNLOCKED. EMERGENCY PUSH BUTTON UNLOCKS ALL INTERLOCKED DOORS FOR EMERGENCY ACCESS. NOTE, DOOR CONNECTED TO MULTIPLE INTERLOCKS. \*COORDINATE INSTALLATION WITH SYSTEM INTEGRATOR. SYSTEM INTEGRATOR TO VERIFY OPERATION AND CONFIRM ALL COMPONENTS REQUIRED.

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**HARDWARE SET: 3**

**DOOR NUMBER:**

146A

**EACH TO HAVE:**

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PUSH/PULL LATCH	HL6 9070 2 3/4" A	630	SCH
1	EA	CYLINDER	1E74	626	BES
1	EA	MAGNETIC LOCK	M450P 12/24 VDC	628	SCE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS (PREP/NOTCH FOR HARDWARE AS REQUIRED)	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	DOOR BOTTOM	355AA (CONFIRM COMPATIBILITY WITH FRP DOOR)	AA	ZER
1	EA	MOUNTING BRACKET	870SPB		ZER
1	EA	PUSH TO LOCK BUTTON	10PTLBUTTON	630	BEA
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	EMER RELEASE BUTTON	CB401-B	630	SDC
1	EA	OCC INDICATOR LIGHT	CM-AF550	630	CAM
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		

OPERATION: DOOR NORMALLY CLOSED AND UNLOCKED. OPENING DOOR LOCKS MAG LOCK AT OPPOSING INTERLOCK DOOR FROM BOTH SIDES UNTIL DOOR CLOSES. OPENING OPPOSING DOORS LOCKS MAG LOCK ON THIS DOOR FROM BOTH SIDES UNTIL OPPOSING DOOR CLOSES. WHEN DOOR IS CLOSED PRESSING LOCK BUTTON LOCKS MAG LOCK FOR PRIVACY AND ILLUMINATES INDICATOR LIGHT. LEAVING 146A OR 146D RESETS SYSTEM. EMERGENCY PUSH BUTTON UNLOCKS BOTH DOORS FOR EMERGENCY ACCESS. FREE EGRESS UNLESS OPPOSING INTERLOCK DOOR IS OPEN.

\*COORDINATE INSTALLATION WITH SYSTEM INTEGRATOR. SYSTEM INTEGRATOR TO VERIFY OPERATION AND CONFIRM ALL COMPONENTS REQUIRED.

\*NOTE DOOR IS INTERLOCKED WITH 146/148B AND 146D.

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**HARDWARE SET: 4**

DOOR NUMBER:

146D

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PUSH/PULL LATCH	HL6 9070 2 3/4" A	630	SCH
1	EA	CYLINDER	1E74	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE CON 12/16/24/28 VAC/VDC	630	VON
1	EA	MAGNETIC LOCK	M450P 12/24 VDC	628	SCE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	ARMOR PLATE	8400 34" X 1" LDW B-CS (PREP/NOTCH FOR HARDWARE AS REQUIRED)	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	MOUNTING BRACKET	870SPB		ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	EMER RELEASE BUTTON	CB401-B	630	SDC
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		
1			CARD READER - WORK OF DIVISION 28		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. CARD READER FOR EMERGENCY/MAINTENANCE USE ONLY. VALID CARD READ UNLOCKS DOOR AND DEACTIVATES INTERLOCK WITH 146A. OPENING DOOR LOCKS OPPOSING DOOR FROM BOTH SIDES UNTIL DOOR CLOSES. FREE EGRESS UNLESS OPPOSING INTERLOCK DOOR IS OPEN. EMERGENCY PUSH BUTTON UNLOCKS BOTH DOORS FOR EMERGENCY ACCESS.  
\*COORDINATE INSTALLATION WITH SYSTEM INTEGRATOR. SYSTEM INTEGRATOR TO VERIFY OPERATION AND CONFIRM ALL COMPONENTS REQUIRED.

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**HARDWARE SET: 5**

DOOR NUMBER:

149

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PUSH/PULL LATCH	HL6 9070 2 3/4" A	630	SCH
1	EA	CYLINDER	1E74	626	BES
1	EA	SURFACE CLOSER	4040XP H SRI	689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	630	IVE
2	EA	FRAME CORNER GUARD	FG8000-42	630	TRI
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

**HARDWARE SET: 6**

DOOR NUMBER:

146B                      146C                      148B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			HARDWARE BY DOOR MANUFACTURER		

**HARDWARE SET: 7**

DOOR NUMBER:

144                      145                      147

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			EXISTING DOOR, FRAME AND HARDWARE TO REMAIN		

NOTE: INTERLOCK WITH NEW DOOR 146. EXAMINE EXISTING CONDITIONS AND PROVIDE APPROPRIATE WIRING/LOGIC.

**HARDWARE SET: 8**

DOOR NUMBER:

150

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			EXISTING DOOR, FRAME AND HARDWARE TO REMAIN		

NOTE: MODIFY CARD ACCESS AS REQUIRED.

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**SECTION 08 80 00 - GLAZING**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes glazing for the following products:

- 1. Vision lites.

1.3 SUBMITTALS

- A. Product data for each glass product and glazing material indicated.

1.4 QUALITY ASSURANCE

- A. Glazing Publications: Comply with "FGMA Glazing Manual" and "LSGA Design Guide," except where more stringent requirements are indicated.
- B. Safety Glass: ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC).
- C. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar to that indicated for Project.
  - 1. Note that the glazing subcontractor shall provide safety glazing in all locations where required by the Building Code whether shown on the drawings or not.
    - a. The glazing subcontractor shall verify which version of the Building Code has been adopted by the governing authority where the project will be built.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials.



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## 1.6 WARRANTY

- A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contactor under requirements of the Contract Documents.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, provide products of the following:
  - 1. CLEAR SAFETY GLASS
    - a. Description: Type I, Class 1, Quality q3, Kind FT, Condition A.
    - b. Thickness: 1/4" unless otherwise noted.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with installation tolerances; minimum required face or edge clearances; and effective sealing between joints of glass-framing members.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

### 3.3 GLAZING

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass from edge damage during handling and installation. Use a rolling block in rotating glass to prevent damage to corners. Use suction cups to shift glass within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges.
- C. Apply primers to joint surfaces where required for adhesion of sealants.

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- D. Install elastomeric setting blocks, sized and located to comply with glazing standard. Set blocks in thin course of sealant suitable for heel bead.
- E. Provide spacers for glass sizes larger than 50 united inches. Provide 1/8 inch minimum bite and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- F. Provide edge blocking to comply with requirements of referenced publications.

### 3.4 PROTECTION AND CLEANING

- A. Protect glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction for build-up of alkali deposits or stains and remove as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.
- D. Wash glass on both faces in each area of Project not more than 4 days prior to Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08 80 00

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## **SECTION 08 91 19 – LOUVERS**

### **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. Extruded-aluminum louvers.

#### **1.3 DEFINITIONS**

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - 2. Show frames and hardware associated with hinged louver.
- C. Samples: For each type of metal finish required.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified

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testing agency, for each type of louver and showing compliance with performance requirements specified.

- B. Windborne-debris-impact-resistance test reports.

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as required.

- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.3 EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Continuous-Line, Wind-Driven-Rain-Resistant Louver:

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Company, Model EME420DD or equal if and as specifically approved by Architect by Addendum during the bidding period.
2. Louver Depth: 4 inches.
3. Frame Nominal Thickness: Not less than 0.081 inch.
4. Blade Nominal Thickness: Not less than 0.063 inch.
5. Where indicated on drawings, provided hinged frame variation with continuous hinge, locking hardware, and frame to match louver frame.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
  2. Finish: Same finish as louver frames to which louver screens are attached.
  3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
  1. Bird Screening: Flattened, expanded aluminum,  $\frac{3}{4}$  by 0.050 inch thick.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For color-finished louvers, use fasteners with heads that match color of louvers.

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- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Interior flange unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: To match "Zinc Grey" of adjacent formed metal wall panels as specified in Section 07 42 13.

## PART 3 EXECUTION

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### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 "Joint Sealants" for sealants applied during louver installation.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.



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- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 19

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## **SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
- 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

- B. Related Requirements:

- 1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
- 2. Section 09 29 00 "Gypsum Board".

#### 1.3 ACTION SUBMITTALS

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

### **PART 2 PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

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

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## 2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, **G40 (Z120)**, hot-dip galvanized unless otherwise indicated.
- C. Studs and Runners: ASTM C 645.
  - 1. Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness, unless otherwise indicated:
      - 1) Framing behind standard panels: 0.0428" inches
      - 2) Framing behind impact resistant panels: 0.0428" inches
    - b. Depth: **3-5/8 inches (92 mm)** unless otherwise indicated.
- D. Slip-Type Head Joints: Where indicated, provide the following:
  - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base Metal Thickness: **0.053-inch (1.34-mm)**
- G. Cold-Rolled Channel Bridging: Steel, **0.053-inch (1.34-mm)** minimum base-metal thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
  - 1. Depth: 1-1/2 inches
  - 2. Clip Angel: Not less than 1-1/2 inches by 1-1/2 inches, 0.068 inches thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

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1. Minimum Base-Metal Thickness: **0.033 inch (0.84 mm)**.
  2. Depth: As indicated on Drawings.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches (32 mm)**, wall attachment flange of **7/8 inch (22 mm)**, minimum uncoated-metal thickness of **0.018 inch (0.45 mm)**, and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- B. Hanger Attachments to Concrete:
1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.16 inch (4.12 mm)** in diameter.
- D. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. [Armstrong World Industries, Inc.; Drywall Grid Systems.](#)
    - b. [Chicago Metallic Corporation; Drywall Grid System.](#)
    - c. [USG Corporation; Drywall Suspension System.](#)
    - d. Or equal if and as specifically approved by Architect by Addendum during the bidding period.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

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2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch (3.2 mm)** thick, in width to suit steel stud size.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches (610 mm)** o.c.
  2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

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- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: **16 inches (406 mm)** o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (13-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

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- a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
1. Screw to wood framing.
  2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- F. Z-Furring Members:
1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-furring members spaced **24 inches (610 mm)** 600 mm o.c.
  2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
  3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches (305 mm)** from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: **48 inches (1219 mm)** o.c.
  2. Carrying Channels (Main Runners): **48 inches (1219 mm)** o.c.
  3. Furring Channels (Furring Members): **16 inches (406 mm)** o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

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2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  5. Do not attach hangers to steel roof deck.
  6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16



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## **SECTION 09 29 00 - GYPSUM BOARD**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Cement Board.
- B. Related Requirements:
  - 1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 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.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

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1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### 2.2 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. [American Gypsum](#).
  2. [CertainTeed Corp.](#)
  3. [Georgia-Pacific Gypsum LLC](#).
  4. [National Gypsum Company](#).
  5. [USG Corporation](#).
  6. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
  1. Core: **5/8 inch (15.9 mm)**, Type X.
  2. Long Edges: Tapered.
  3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

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## 2.4 CEMENT BOARD

A. Cement Board: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. **Products:** Subject to compliance with requirements, provide one of the following:
  - a. **Custom Building Products;** Wonderboard.
  - b. **FinPan, Inc.;** Util-A-Crete Concrete Backer Board.
  - c. **USG Corporation; DUROCK Cement Board.**
  - d. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
2. Thickness: **1/4 inch.**
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - e. Expansion (control) joint.

## 2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Cement Board: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

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- a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Cement Board:
1. Cement Board: As recommended by backer unit manufacturer.

## 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
  2. For fastening Cement Board, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. [Accumetric LLC; BOSS 824 Acoustical Sound Sealant.](#)
    - b. [Grabber Construction Products; Acoustical Sealant GSC.](#)
    - c. [Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.](#)
    - d. [USG Corporation; SHEETROCK Acoustical Sealant.](#)
    - e. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

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## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

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- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. 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 C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

#### A. Single-Layer Application:

- 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
- 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
- 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 3.4 INSTALLING 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 C 840 and in specific locations approved by Architect for visual effect.
  - 1. If control joints are not shown on the drawings they shall be located at a maximum of 30 feet o.c. Coordinate exact location with Architect prior to installation.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. L-Bead: Use where indicated.

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4. U-Bead: Use where indicated.
5. Curved-Edge Cornerbead: Use at curved openings.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840 and Gypsum Association GA-214-10.
  1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 4: All locations.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- E. Cement Board: Finish according to manufacturer's written instructions.

### 3.6 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 09 29 00



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## SECTION 09 65 13 – RESILIENT BASE AND 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. Resilient base.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than **50 deg F (10 deg C)** or more than **90 deg F (32 deg C)**.

#### 1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **70 deg F (21 deg C)** or more than **95 deg F (35 deg C)**, in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**.

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- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 THERMOSET-RUBBER BASE

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. [Burke Mercer Flooring Products, Division of Burke Industries Inc.](#)
  - 2. [Flexco.](#)
  - 3. [Roppe Corporation, USA.](#)
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style:
    - a. Style B, Cove
- C. Thickness: **0.125 inch (3.2 mm)**.
- D. Height: **4 inches (102 mm)**.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Pre-formed.
- G. Inside Corners: Pre-formed.
- H. Colors: As selected by Architect from full range of industry colors.

### 2.2 INSTALLATION MATERIALS

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

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## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

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- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 13

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## **SECTION 09 67 33 – TROWEL-APPLIED RESINOUS FLOORING**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Sections, apply to work of this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Seamless resinous flooring.
  - 2. Coved seamless wall base.

#### **1.3 QUALITY ASSURANCE**

- A. All materials must be recommended and manufactured by a single supplier to insure compatibility and proper chemical and mechanical bond.
- B. Surfacing shall be applied by a surfacing applicator approved by the Architect, with a minimum of seven (7) years experience installing the brand of surfacing in similar size and function projects. A list of ten (10) completed projects using the specified materials must be submitted proving seven (7) years experience by the lead mechanic.
- C. Surfacing applicator shall provide to the architect a completed list of jobs including the names of the Architect, General Contractor, Owner, telephone numbers of all concerned, materials used, quantity installed and date completed on similar projects.
- D. Surfacing applicator must provide a written guarantee for materials and workmanship between applicator and surfacing manufacturer for one (1) year.
- E. Surfacing applicator or manufacturer seeking approval of products other than what is specified must supply samples, full product information, technical data with specifications, certification from an independent testing laboratory that the product being submitted for approval meets all requirements of the performance properties specified within this specification, installation instructions and comply with the above quality assurances in writing fourteen (14) days before bid letting. Omission of any item will result in an automatic rejection.
- F. Bidders will be notified by addendum of substitute surfacing materials, if approved.

#### **1.4 SUBMITTALS**

- A. Surfacing applicator shall submit samples of color and textures for Architect's approval.
- B. Prior to commencing work, applicator shall install a 18" x 18" square mockup on the job of desired

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color and texture and when approved, this will serve as the standard for the entire project.

1.5 PRODUCT STORAGE AND ENVIRONMENTAL CONDITIONS

- A. Material temperatures shall be a minimum of 55°F before use.
- B. Work on seamless flooring shall not commence until the building can be maintained at a minimum temperature of 55°F for 48 hours before, during and 48 hours after application. Areas shall also be broom clean and reasonably dust free and shall have adequately controlled ventilation with bright, uniform lighting.

1.6 PROJECT CONDITIONS

- A. Before commencing work, ensure environmental and site conditions are suitable for application and curing.
- B. Surfaces shall be acceptable in accordance with flooring manufacturer's recommendations.
- C. Notify Architect and Contractor in writing of unsuitable surfaces and conditions. Commencement of work shall imply acceptance of surfaces and working conditions.
- D. Recommended Moisture Vapor Transmission Considerations:
  - 1. Placement of on-grade slabs over a Class A vapor retarder as defined by ASTM E-145.
  - 2. A water cement ratio of 0.45 and 0.5.
  - 3. Curing by ASTM C-171 sheet materials for curing concrete.
  - 4. A slump in the range of 3 to 4 inches which can be increased by the use of super plasticizers.

1.7 PROTECTION

- A. Protect adjacent surfaces from damage resulting from work of this trade. If necessary, mask and/or cover adjacent surfaces, fixtures, cabinet work, equipment, etc. by suitable means.

1.8 WARRANTY

- A. Manufacturer's written warranty against defects and wear for a period of five (5) years, including:
  - 1. Delamination from substrate.
  - 2. Loss of aggregate.
  - 3. Degradation of finish.
  - 4. Cracking and spalling
  - 5. Water penetration.

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## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Seamless Floor and wall Covering where called for on the drawings, basis-of-design product:

- a. **Desco Quartz Cremona TG With SR CO POLYMER (No Broadcast allowed)** Floor manufactured by Desco Coatings, Inc. **1-800-426-4164.**

**Or equal product by**

- b. Tennant Company  
c. Stonhard®, Inc  
d. Tnemec Company

B. Provide cove base with radius cove as indicated on drawings and vertical application of flooring to height indicated.

B. Binder and all successive grout and top coats shall be 100% solids clear/epoxy resin.

C. Finish shall utilize a single color of quartz, selected by architect to match existing flooring color. No color mixes shall be used.

D. Minimum Performance Characteristics:

1.	Compressive Strength (ASTM C-579)	10,000 psi
2.	Tensile Strength (ASTM C-307)	2,250 psi
3.	Flexural Strength	4,000 psi
4.	Shore D Hardness (ASTM D-2240)	85-90
5.	Bond Strength (ASTM D-4541)	425 psi
6.	Abrasion Resistance (ASTM D-4060)	0.08 gm
7.	Pot Life	35 min
8.	Cure Time @ 77° F	10-12 hours

Epoxy top coats shall produce no color shift after exposure to fluorescent lighting on the "b" axis yellow index after 3 weeks exposure.

20% Hydrochloric Acid	10% Lactic Acid
Urine	Tea
Coffee	Mustard
Ethyl Alcohol	Mercurochrome
	Betadyne

## PART 3 EXECUTION

### 3.1 TESTING OF CONCRETE SUBSTRATE

A. One of the following three methods shall be used to determine moisture content of slab at time of application. These test only measure the specific area tested at the time of the test and are not



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predictors of future substrate conditions.

- B. Using a Tramax concrete moisture detection device, firmly apply the test apparatus to concrete that has had sealers or other subsequent coatings removed. The readings shall be 4.2% or less. If readings are higher, use ASTM F-2170 for non conditional spaces and/or ASTM F1869 for conditioned spaces.
- C. ASTM F-2170 in site Relative Humidity Test. Follow test procedures of manufacturer of testing equipment. Reading should be below 80%.
- D. ASTM F-1869 Calcium Chloride Moisture Vapor Transmission Test. Follow test procedures of manufacturers of MVT kits. Results should be below 3 to 4 lbs/1,000 square feet/24 hours.

### 3.2 FLOORING PREPARATION

- A. Surface must be clean, sound and dry.
- B. Effectively remove concrete laitance on accessible floor surfaces by mechanical shot blast. Acid etching is not acceptable.
- C. Areas where flooring is existing must be cleaned to remove all floor material, grease or any residue that might retard interfacial adhesion between substrate and surfacing. Installer shall prepare existing flooring and wall base as required and provide testing as required to ensure adhesion.

### 3.3 FLOORING APPLICATION

- A. Apply flooring in accordance with manufacturer's printed instructions, employing lead mechanic qualified under the quality assurance portion of this specification, using equipment specifically designed for this purpose.
- B. Desco Quartz Cremona TG is a hand troweled grade 11 Desco quartz aggregate with 20% of grade 28 as a filler. The system should be hand troweled to 3/16" thickness over epoxy primer.
  - 1. All necessary fill for sloping to drains to be Desco epoxy resin and selected aggregate. If thickness is greater than 2", apply in multiple lifts.
- C. Install cove base to height as indicated with radius cove.
  - 1. Trowel apply vertical cove base.
  - 2. Hand sand
  - 3. Apply three coats of resin to assure a smooth surface and cove.
  - 4. Do not allow resin to puddle in cove.

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- D. Apply SR60 aggregate on floor for slip resistance. Amount to be determined on actual mock-up from end user.
- E. Finished work shall match approved samples; be uniform in thickness, sheen, color, pattern, and texture; and be free from defects detrimental to performance.

3.4 PROTECTION

- A. After completion of flooring the General Contractor/Owner shall protect flooring from damage by other trades.

END OF SECTION 09 67 33

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## **SECTION 09 91 13 - EXTERIOR PAINTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
  - 1. Steel and iron (including factory-primed).
- B. Related Requirements:
  - 1. 08 11 13 "Hollow Metal Doors and Frames" for factory-primed finishes.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 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.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: Not less than 1 gal. of each material and color applied.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

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- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS**

2.1 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- C. Colors: Match existing Phase 1 building

**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. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.

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1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. 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.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  1. Use applicators and techniques suited for paint and substrate indicated.
  2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

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- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Ensure that edges, corners, crevices, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. Recoat primed and sealed surfaces where evidence of unsealed areas in first coat appears.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Allow sufficient time between successive coats to permit proper drying.
- F. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.
- G. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- H. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts and labels. Painting is required on all new items included in the work.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINT SCHEDULE

LOCATION	SHEEN	PAINT SYSTEM
Exterior Pre-Painted Steel	Semi-Gloss	EPS-1X
Exterior Painted Steel	Semi-Gloss	EPS-2X

### 3.6 EXTERIOR PAINTING SYSTEMS

- A. System EPS-2X for application on Exterior Painted Steel Ferrous Metal:

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1. Semi-Gloss Latex Finish: Apply two (2) coats over primer with total dry film thickness not less than 2.5 mils.
2. Acrylic, Rust-Inhibiting Primer: Quick-drying, rust-inhibiting primer for priming ferrous metal on the interior under waterborne semi-gloss enamels:
  - a. DV: Diamond Prime Universal Primer.
  - b. Moore: SuperSpec HP Acrylic Metal Primer #P04/KP04.
  - c. P & L: Acrylic Waterborne Bonding Primer Z6650.
  - d. PPG Paints: Breakthrough, #V70.
  - e. SW: Pro-Cryl Universal Metal Primer, B66 W 310.
3. Exterior Acrylic Semi-Gloss Paint for use over a primer on exterior ferrous surfaces:
  - a. DV: Vers-Acryl 222 Acrylic Maintenance Semi-Gloss.
  - b. Moore: SuperSpec DTM Acrylic Semi-Gloss #P29/KP29.
  - c. P & L: Acrylic Waterborne DTM Semi-Gloss Z6761 .
  - d. PPG Paints: PittTech Plus Semi-Gloss DTM Industrial Enamel #90-1210.
  - e. SW: DTM Acrylic Semi-Gloss, #B66-200 Series.

END OF SECTION 09 91 13



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## **SECTION 09 91 23 - INTERIOR PAINTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on interior substrates.
  - 1. Concrete.
  - 2. Concrete masonry units (CMU).
  - 3. Gypsum board.
- B. Related Sections:
  - 1. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
  - 2. Division 09 Sections for special use-coatings.
  - 3. Section 09 96 00 "High-Performance Coatings".

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Step coats on Samples 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: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

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#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

### **PART 2 - PRODUCTS**

#### 2.1 PAINT, GENERAL

- A. 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.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 150 g/L.

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3. Dry-Fog Coatings: 400 g/L.
  4. Primers, Sealers, and Undercoaters: 200 g/L.
  5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  6. Pretreatment Wash Primers: 420 g/L.
- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Colors: Match existing facility standard.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMU): 12 percent.
  3. 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. 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.

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- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
  - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
  - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable in writing to topcoat manufacturers.
  - 6. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures are in place and all areas as specified herein. Extend paint finishes in these areas as required. If color is not designated, the Architect will select from standard colors.

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- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance. Ensure that edges, corners, crevices, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. Recoat primed and sealed surfaces where evidence of unsealed areas in first coat appears.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Allow sufficient time between successive coats to permit proper drying.
- F. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.
- G. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment including all mechanical equipment and materials.
- H. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels. Painting is required on all new items included in the work.
- I. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- J. Finish doors on tops, bottoms and side edges same as faces.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

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- E. Provide “wet paint” signs to protect newly painted finishes.

3.5 INTERIOR PAINT SCHEDULE

<u>LOCATION</u>	<u>SHEEN</u>	<u>PAINT SYSTEM</u>
Interior CMU/Concrete/Brick	Semi-Gloss	CMU-21
Interior Gypsum Drywall	Semi-Gloss	GDW-4I

3.6 INTERIOR PAINTING SYSTEMS

A. System CMU-21 for application on Interior Concrete/CMU/Brick:

1. Semi-Gloss Latex Enamel Finish: 2 coats over filled surface with total dry film thickness not less than 3.5 mils excluding filler coat.
2. High Performance Latex Block Filler: Heavy Duty latex block filler used for filling open textured interior concrete masonry block before application of top coats:
  - a. DC: Dia-Pro Interior/Exterior Block Filler, BF1515.
  - b. GP: Prep & Prime Block Filler Interior/Exterior Water-Based Primer, 3010-1200.
  - c. Kwal: Accu-Pro Latex Block Filler, 5890.
  - d. P & L: Enducryl Heavy Duty Acrylic Block Filler, Z8465 Series.
  - e. PPG Paints: SpeedHide Acrylic Block Filler, 6-15 Series.
  - f. S-W: PrepRite Interior/Exterior Block Filler, B25W25.
  - g. S-W: Heavy Duty Block Filler, B42W46.
3. Interior Semi-Gloss Odorless Latex Enamel: 2 coats of Low odor, semi-gloss, enamel for use over a primer on concrete and masonry.
  - a. DC: “WonderPure” Low Odor Interior Latex Semi-Gloss recommended for substrate listed.
  - b. DV: “Health-Kote” Low Odor Interior Semi-Gloss Latex, DS-1591 (0 VOC).
  - c. Kwal: “Envirokote” Semi Gloss, 3310.
  - d. P & L: Pro-Hide Gold Interior Low Odor Latex Semi-gloss, Z9300 Series.
  - e. PPG Paints: Speedhide 6-4500 Zero VOC Interior Latex Semi-Gloss.
  - f. PPG Paints: “Pure Performance” Interior Latex Semi-Gloss Enamel, 9-500 Series.
  - g. S-W: ProMar 200 Zero VOC Semi-Gloss, B31 Series.
  - h. S-W: “Harmony” Interior Latex Semi-Gloss, B10 Series.

B. System GDW-3I for application on Interior Gypsum Drywall—Typical Walls:

1. Eggshell Latex Enamel Finish: 2 finish coats over primer.

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2. Latex-Based Interior White Primer: Latex-based primer coating used on interior gypsum drywall under a eggshell latex paint.
  - a. Devoe: “WonderPure” Primer recommended for substrate listed.
  - b. DV: “Health-Kote” Low Odor Primer/Flat Finish, DF-1591.
  - c. Kwal: “Envirokote” Primer, 08300.
  - d. Moore: “Pristine ECO-Spec” Primer, 231.
  - e. P & L: Pro-Hide Gold Interior Low Odor Latex Primer, Z9165.
  - f. PPG Paints: “Pure Performance” Interior Latex Primer, 9-900 Series.
  - g. S-W: ProMar 200 Zero VOC Interior Latex Primer, B28 Series.
  - h. S-W: “Harmony” Interior Latex Primer, B11W900.
  
3. Eggshell Latex Enamel: Latex-based paint for use as an eggshell finish over prime-coated gypsum drywall.
  - a. Devoe: “WonderPure” Low Odor Interior Latex Eggshell recommended for substrate listed.
  - b. DV: “Health-Kote” Low Odor Interior Latex Eggshell, DE-1591.
  - c. Kwal: “Envirokote” Eggshell, 2510.
  - d. Moore: “Pristine ECO-Spec” Low Odor Interior Latex Eggshell, 223.
  - e. P & L: Pro-Hide Gold Interior Low Odor Latex Eggshell, Z9200 Series.
  - f. PPG: “Pure Performance” Interior Eggshell Latex, 9-300 Series.
  - g. S-W: ProMar 200 Zero VOC Eggshell, B20 Series.
  - h. S-W: “Harmony” Interior Latex Eggshell, B9 Series.

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## **SECTION 09 96 00 – 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

1.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. 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. Label each Sample for location and application area.
- D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.4 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: Not less than 1 gal. each material and color applied.

#### 1.5 QUALITY ASSURANCE

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- A. **Installer Qualifications:**An experienced installer who employs only persons trained and approved by special coatings manufacturer for applying special coatings systems indicated.
  - 1. Qualifications of installers for special coatings system shall not be less than five years of experience installing specified items. Special coatings installer shall be manufacturer approved and have performed at least ten similar installations.
- B. **Single-Source Responsibility:** Provide primers and undercoat material produced by the same manufacturer as the finish coats for each type of coating. Use only thinners recommended by the manufacturer and only within recommended limits.
- C. **Mock-ups:** Apply mock-ups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

## 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 HIGH-PERFORMANCE COATINGS, GENERAL

- A. **Material Compatibility:**
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

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2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

## 2.2 SOURCE QUALITY CONTROL

### A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Masonry (Clay and CMUs): 12 percent.
  2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify compatibility with and suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

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- G. Notify the Architect of problems anticipated using the coatings specified over substrates primed by others.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations 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.
  - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
- 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.

### 3.3 APPLICATION

- A. **Provide finish coats compatible with the primers used.**
- B. Apply high-performance coatings according to manufacturer's written instructions and recommendations.
  - 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.

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- a. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
  - D. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
  - E. 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.
  - F. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Where sanding is required, according to the manufacturer’s directions, sand between applications to produce a smooth, even surface.

### 3.4 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.
- E. Provide “Wet Paint” signs to protect newly coated finishes.
- F. Refer to the drawings, room finish schedules and notes for paint requirements. Architect shall approve all “match adjacent surfaces” colors before painting begins.

### 3.5 HIGH-PERFORMANCE COATINGS, GENERAL

HIGH-PERFORMANCE COATINGS

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A. Material Compatibility.

1. Provide materials for use within each coating 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. Provide products of same manufacturer for each coat in a coating system.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing 1 or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
  - a. Acrolein.
  - b. Acrylonitrile.
  - c. Antimony.
  - d. Benzene.
  - e. Butyl benzyl phthalate.
  - f. Cadmium.
  - g. Di (2-ethylhexyl) phthalate.
  - h. Di-n-butyl phthalate.
  - i. Di-n-octyl phthalate.
  - j. 1,2-dichlorobenzene.
  - k. Diethyl phthalate.
  - l. Dimethyl phthalate.
  - m. Ethylbenzene.
  - n. Formaldehyde.
  - o. Hexavalent chromium.
  - p. Isophorone.
  - q. Lead.
  - r. Mercury.
  - s. Methyl ethyl ketone.
  - t. Methyl isobutyl ketone.
  - u. Methylene chloride.
  - v. Naphthalene.
  - w. Toluene (methylbenzene).
  - x. 1,1,1-trichloroethane.
  - y. Vinyl chloride.

C. Colors: Match existing adjacent similar surfaces.

D. HIGH-PERFORMANCE COATINGS SCHEDULE

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<u>LOCATION</u>	<u>SHEEN</u>	<u>COATINGS SYSTEM</u>
Interior Ferrous Metal	Semi-Gloss	IFM-1X
Interior CMU (Aliphatic Epoxy)	High-Performance	CMU-41
Interior Gypsum Drywall (Epoxy)	Semi-Gloss	GDW-51

### 3.6 INTERIOR HIGH-PERFORMANCE COATING SYSTEMS

#### A. System IFM-1X for application on Interior Ferrous Metal—Solid color:

1. Semi-Gloss Acrylic Polymer: 2 finish coats over an epoxy primer. (Primer to be applied by metal fabricator in shop.)
2. Metal Primer: Epoxy primer used to touch-up primed interior ferrous metal surfaces.
  - a. Thickness: 2.5 – 3.5 mils.
  - a. PPG Paints: Amerlock, 2/400.
  - b. Tnemec: Epoxoline, Series 66.
  - c. Or equal, if and as specifically approved by Architect by Addendum during bidding period.
3. Thermoset Semi-Gloss Fluoro-Polymer: Opaque coat for use over primed, ferrous metal surfaces: Color as selected by Architect from manufacturer's standards.
  - a. Thickness: 3 – 4 mils.
  - b. PPG Paints: Corafon ADS (solid color).
  - c. Tnemec: HDP Acrylic Polymer, Series 1029.
  - d. Or equal, if and as specifically approved by Architect by Addendum during bidding period.

#### B. System CMU-41 for application on Interior CMU:

1. Semi-Gloss Aliphatic Epoxy Finish: Apply 2 coats with total dry film thickness not less than 18 mils over clean and dry surface, free of all form release agents. **Backroll both coats to create a pinhole free surface. If a pinhole free surface is not achieved a third coat shall be applied at no additional cost to owner.**
2. High Performance Epoxy Surfacer:
  - a. PPG Paints: Amerlock®, 400BF Epoxy Masonry Block Filler, applied at 10 - 20 dry mils.
  - b. SW: Kem Cati-Coat® HS Epoxy Filler/Sealer, B42W00400.
  - c. Tnemec: Ceramlon, Series 84 applied at 80 – 125 sq. ft. per gallon.
  - d. Or equal, if and as specifically approved by Architect by Addendum during bidding period.
3. Interior Semi-Gloss Aliphatic Epoxy Finish: Color as selected by Architect from manufacturer's standards:



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- a. PPG Paints: Amerlock®, 2VOC, applied at 4 - 8 dry mils per coat.
  - b. SW: Pro Industrial High Performance Epoxy (Part A) Pure White/Tint Base B67-200 Series.
  - c. Tnemec: Ceramlon, Series 84 applied at 125 – 150 sq. ft. per gallon.
  - d. Or equal, if and as specifically approved by Architect by Addendum during bidding period.
- C. System GDW-51 for application on Interior Gypsum Drywall: (Use at food prep and kitchen walls to comply with ASTM D3730)
1. Semi-Gloss Latex Epoxy Finish: 2 finish coats over primer.
  2. Latex-Based Interior White Primer: Latex-based primer coating used on interior gypsum drywall under an epoxy finish:
    - a. PPG Paints: “Pure Performance” Interior Latex Primer, 9-900 Series.
    - b. SW: “Harmony” Interior Latex Primer, B11W900, applied at 4 mils wet, 1.3 mils dry per coat.
    - c. Tnemec: Series 151 Elasto-Grip.
    - d. Or equal, if and as specifically approved by Architect by Addendum during bidding period.
  3. Semi-Gloss Latex Epoxy Finish: Color as selected by Architect from manufacturer’s standards:
    - a. PPG Paints: Pitt-Glaze WB Water Borne Acrylic Epoxy, 16-551.
    - b. SW: Water-Based Catalyzed Epoxy (Semi-Gloss finish), B70W211 / B60V25, applied at 2.5 – 3 mils dry per coat.
    - c. Tnemec: Series 113 H.B. Tneme-Tufcoat waterborne acrylic epoxy gloss.
    - d. Or equal, if and as specifically approved by Architect by Addendum during bidding period.

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## **SECTION 10 21 19 - PLASTIC TOILET COMPARTMENTS**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

#### 1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

- B. Shop Drawings: For doors.

- 1. Include plans, elevations, sections, details, and attachment details. Include manufacturer's standard colors for selection.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

#### 1.6 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 and source.

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1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

**PART 2 PRODUCTS**

2.1 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Accurate Partitions Corporation.
  2. Bradley Corporation; Mills Partitions.
  3. Hadrian Manufacturing Inc.
  4. Scranton Products
  5. Or equal, if and as specifically approved by Architect by Addendum during the bidding period.
- B. Door Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
  3. Color and Pattern: in each room as selected by Architect from manufacturer's full range.

2.2 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
1. Hinges: Manufacturer's minimum 0.062-inch- thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
  2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply

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- with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. .
  4. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

#### **3.3 ADJUSTING**

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 19

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## **SECTION 10 26 00 - WALL PROTECTION**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following types of wall surface protection systems:
  - 1. Stainless Steel Rail.
  - 2. Stainless Steel Corner Guards.

#### 1.3 SUBMITTALS

- A. Product data for each wall surface protection system component and installation accessory.
- B. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: For each type of wall protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  - 2. Store materials flat. Do not stand sheets on end.
  - 3. Handling: Protect materials during handling and installation to prevent damage.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

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1. Failures include, but are not limited to, the following:
  - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
  - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
2. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by Manufacturer listed below. Other equivalent products may be accepted if and as specifically approved by Architect by Addendum during bidding period.

1. Life Science Products

### **2.2 STAINLESS STEEL WALL PROTECTION**

- A. Wall protection crash rail: stainless steel Type 304 No. 4 satin, 4" wide mounted on 1 1/2" I-beam bracket.
- B. Corner guard: stainless steel Type 304 No. 4 satin, 4" wide mounted on I-beam bracket, 4x4x72" .063" w/ 1/8" radius.

### **2.3 MATERIALS**

- A. Fasteners: All fasteners to be non-corrosive and compatible with aluminum components. All necessary fasteners to be supplied by the manufacturer.
- B. Adhesive: As recommended by protection product manufacturer.

### **2.4 FABRICATION**

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

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- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.5 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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. Verification of Conditions: Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Do not proceed until after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Prior to installation, clean substrate to remove dust, debris, and loose particles. Follow manufacturer's printed instructions for surface preparation.
- B. Complete finishing operations, including painting, before installing wall and door protection.
- C. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions. Complete finishing operations, including painting, before installing wall and door protection.



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### 3.3 INSTALLATION

- A. **Installation Quality:** Install wall and door protection in strict accordance with the manufacturer's recommendations and written instructions; using only approved mounting hardware, and locating all components firmly in position, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. **Mounting Heights:** Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. **Adhesives:** Adhesive must comply with wall covering manufacturer's installation requirements, providing a mildew-resistant, non-staining, and strippable attachment.

### 3.4 CLEANING

- A. Immediately upon completion of installation, clean wall surface protection systems and accessories in accordance with manufacturer's recommended cleaning methods and materials.
- B. Remove excess adhesive. Leave area of installation in clean, neat condition.

### 3.5 PROTECTION

- A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION 10 26 00

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## **SECTION 10 28 00 – TOILET AND BATH ACCESSORIES**

### **PART 1 GENERAL**

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Framed Mirror
2. Shelf: Satin-Finish Stainless Steel Shelf
3. Clothes (Utility) Hook.
4. Grab Bar: Satin-Finish Stainless Steel, 1-1/2" (38 mm) diameter.

#### 1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  3. Retain subparagraph below if units are required that connect to building electrical system.
  4. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  1. Identify locations using room designations indicated.

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2. Identify accessories using designations indicated.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

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

#### 1.7 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective automated hand dryer components and labor within specified warranty period.

1. Warranty Period: One (1) year limited for labor and five (5) years for parts.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

#### 2.2 FRAMED MIRROR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Bobrick Washroom Equipment, Inc.
  2. Bradley Corporation
  3. Foundations Worldwide, Inc.
  4. Or equal if and as specifically approved by Architect by Addendum during the bidding period.

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- C. Bobrick Washroom Equipment, Inc., Channel Frame, Product #B-165 2436

## 2.3 STAINLESS STEEL WALL SHELF (SSSH)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Bobrick Washroom Equipment, Inc.
  - 2. Bradley Corporation
  - 3. Foundations Worldwide, Inc.
  - 4. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- C. Bobrick Washroom Equipment, Inc., Stainless Steel Shelf, Product # B-295.

- 1. 18-8 S, type 304, 18-gauge (1.2 mm) stainless steel. Shelf shall be 5" W with 3/4" (19 mm) return edges. Front edge shall be hemmed for safe handling. Mounting Brackets—18-8 S, type 304, 16-gauge (1.6 mm) stainless steel. Welded to back return of shelf and secured inside front hem of shelf. Finish: Satin-Finish Type #304 Stainless Steel.

- a. Length: As indicated on drawings.

## 2.4 CLOTHES (UTILITY) HOOK (CH)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Safco
  - 2. Bobrick Washroom Equipment, Inc.
  - 3. Bradley Corporation
  - 4. Foundations Worldwide, Inc.
  - 5. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- C. Safco 4162 Wall Coat Hook.

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1. Description: Heavy-duty wall mounted with six chrome-plated double steel hooks with ball tips.
2. Size: 36 x 33/4 x 7"

D. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

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

#### **3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 28 00

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## **SECTION 11 12 50 – VEHICLE BARRIER SYSTEMS**

### **PART 1 GENERAL**

#### 1.1 SECTION INCLUDES

- A. Automatic barrier gates, barrier gate concrete structural foundations, vehicle detectors.

#### 1.2 RELATED WORK

- A. Access control and communications per Owner.
- B. Electrical service and connections.

#### 1.3 SYSTEM DESCRIPTION

- A. Rising mechanical vehicle security barrier:
  - a. Pre-wired single drop arm vehicle barrier, including all selected attachments and accessory equipment. Complete with all pumps, valves, cylinders and electrical devices to move barrier arm and limit its travel in both directions; single direction traffic flows in one direction only through the system.

#### 1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Test reports:
    - a. Submit affidavits from the manufacturer demonstrating that the barrier mechanism has been tested to 200,000 cycles without breakdown.
    - b. Each operator shall bear a label indicating that the operator mechanism has been tested. Operator is tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.
- B. Shop Drawings:

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1. Show locations and details of vehicle barrier systems including each major element, and details of operation, hardware, and accessories.
  2. Indicate materials, dimensions, sizes, weights, and finishes of components.
  3. Include plans, elevations, sections, foundation drawings and other required installation and operational clearances, and details of anchorage.
  4. Installation procedures and instructions.
  5. Provide a written sequence of operation that includes but not limited to vehicle barrier system sequencing, vehicle loop detector functions, gate arm functions, traffic lights, annunciators and all other equipment directly controlled by the PLC.
  6. Controls and Hydraulics: Show locations and details for control components, switches and hydraulic system. Indicate motor size, hydraulic schematic, electrical characteristics, drive arrangement, mounting, and grounding.
  7. Wiring Diagrams: Power and control wiring, communication features, and access control features. Differentiate between factory-installed and field-installed wiring and between components provided by manufacturer and those provided by other sections of the specification.
  8. Provide a concrete foundation design by licensed engineer registered in the State of Missouri, with seal and signature. The drawing documents provide indication of design intent for design direction.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- D. Sample warranty certificate.
- E. Closeout Submittals:
1. Provide As-Built Drawings showing the as-built conditions of all equipment provided.
  2. Provide manufacturer's maintenance and service instructions that include recommendations for periodic maintenance and cleaning of all vehicle barrier system components including:
    - a. Parts List, or Bill of Material on all major parts and components.
    - b. Recommended Spare and Consumables Parts List. Spare parts shall be those that can be field replaced. Consumables include items required for maintenance and service, such as, lights, fuses, lubricants, hydraulic fluid, filter elements, etc. Provide all items with a part number, recommended quantity, and a brief description.
    - c. Warranty certificate with valid signature from manufacturer and installer.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specializing in the supply of vehicle barrier systems with a minimum of 5 years documented experience.

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- B. Installer Qualifications: Manufacturer-approved and factory authorized installer specializing in the installation of vehicle barrier systems with a minimum of 5 years documented experience.

1.6 WARRANTY

- A. Provide five (5) year manufacturer warranty including parts (per manufacturer) and labor (per installer).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels intact until ready for installation.
- B. Store on pallets, under cover and in a location protected from the weather, humidity, excessive temperature variation, dust, dirt and/or other contaminants.

1.8 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance as recommended by manufacturer for vehicle barrier systems and components for three (3) years from Date of Substantial Completion.
  - 1. Include periodic examination, adjustment, and lubrication of vehicle barrier equipment. Repair or replace parts whenever required. Use parts produced by manufacturer of original equipment.
- B. Provide emergency call back service for this maintenance period.
- C. Perform maintenance work using competent and qualified personnel approved by manufacturer.

**PART 2 PRODUCTS**

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: HySecurity StrongArm M50 with smart touch controller.



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- B. Substitutions: To be considered when complete and comparable qualifications to the basis of design are submitted prior to prebid meeting for design team and Owner evaluation.

## 2.2 OPERATION

- A. Operation shall be by means of dual acting hydraulic cylinder acting directly on the drop arm to move the arm through 90°. The arm travel time varies depending upon version ordered, see schedule below. Operation to the fully open and fully closed position shall be continuously monitored by an absolute position sensing device that accurately reads the position of the cylinder and arm. The system shall function normally without need for springs or weights to counterbalance the arm. Gears, sprockets, belts or pulleys shall not be incorporated in the operator. Arresting of vehicles shall be accomplished by polymeric straps suspended in the arm. All models include a variable speed motor drive and two brake valves to gradually stop and hold the arm without applying a shock load to the arm or barrier assembly. Barrier shall hydraulically lock in the closed position.
- B. The vehicle barrier shall be certified by a third party licensed engineer to be capable of withstanding a direct impact from a vehicle to the M50 level specified in ASTM F2656 for 12 ft (3,657 mm) and 24 ft (7,315 mm) lengths. The vehicle barrier shall have successfully passed testing at an accredited test facility to ASTM F2656 as validation of the engineering certification.
- C. Safety Features shall include as a minimum:
- D. Lower barrier arm at a height of 18" (457 mm) from grade to prevent smaller vehicles from penetrating under the main barrier arm.
- E. The barrier arm shall contain LED warning lights to enhance night visibility.
- F. The barrier shall include a red – amber stoplight to display status to vehicles.
- G. A photoelectric eye capable of detecting a person or vehicle in the path of the barrier to prevent closure of the barrier arm when an obstruction is present. This feature shall not be active during Emergency Fast Close.
- H. Shield to prevent entrapment of bystanders between arm and catch post.
- I. Schedule of length and speed capacities:
  - 1. 16ft clear opening: Travel time not to exceed seven seconds from fully closed to fully open position.
  - 2. All units shall contain, as standard equipment, a provision for Emergency Fast Close operation that shall move the barrier from fully open to the fully closed position in 1.5 seconds less than the normal travel time to open.

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J. Minimum standard mechanical components:

1. Chassis: shall be 3/8" (9 mm) steel plate, welded, and edges ground smooth.
2. Cover: shall be 14 gauge (2 mm) galvanized sheet steel, with a security lock to limit access.
3. Main shaft: shall be 3" (76 mm) diameter, high strength steel alloy.

K. Heavy duty sealed 1-15/16" (49 mm) bearings, with cast iron pillow blocks.

L. Resilient physical stop limiting open and close travel and to cushion stop at each end of travel.

M. Hydraulic hose: Shall be 3/8" (9 mm) wire braid reinforced, rated to 3,050 psi (21.0 MPa).

N. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.

O. Hydraulic fluid: High performance type with a viscosity index greater than 375 and temperature range -40° F to 158° F (-40° C to 70° C). optional biodegradable fluid requires a heater at temperatures below -10° F (-24° C).

P. A zero to 2,000 psi (13.7 MPa) pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.

Q. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.

R. Manual operation: in the event of a power outage the use of a "pull to release" bypass valve shall unlock the operator and allow the arm to be operated by a hand pump.

S. Arm: Aluminum oval shape for optimal strength, wind resistance and corrosion protection

T. Arm striping: shall be highly reflective alternating red and white vertical stripes, 16" (406 mm) intervals measured horizontally per MUTCD standards.

U. Finish: hot dipped galvanize coating per ASTM A123 G85.

V. Red LED lights shall be integrated into the barrier arm.

2.3 Minimum standard electrical components:

A. Pump motor: 2 hp, 3450 RPM, 56C, TEFC, three phase. (Note, the VFD converts single phase input power to drive a three phase motor)

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- B. All components shall have overload protection.
  - C. Variable frequency drive to enable variable displacement pump operation.
  - D. Controls: Smart Touch Controller Board containing:
    - 1. Built in warning buzzer for Emergency Fast Close and in the event of Alerts, Faults, or Errors.
    - 2. Built in timer to close.
    - 3. 32 character OLED display for reporting of functions and codes;.
    - 4. Multiple programmable output relay options;
    - 5. Anti-tailgate mode.
    - 6. Built-in power surge/lightning strike protection.
    - 7. Menu configuration, event logging and system diagnostics.
    - 8. RS-232 port for connection to laptop or other computer peripheral and RS-485 connection for network interface.
    - 9. Dual gate communication connection for bi-parting, sally port, or sequenced gates.
    - 10. Electromechanical and solid state relays.
    - 11. Radio option outputs.
    - 12. 21 inputs for site specific configurations.
  - E. Control circuit: 24 VDC.
  - F. Transformer: 75 VA, non-jumpered taps, for all common voltages.
  - G. Sockets for up to four (4) minimum plug-in vehicle detectors.
  - H. Open and close limits shall be via encoder, providing continuous position sensing of arm position and the stop positions shall be adjustable from the controller with an LCD display.
- 2.4 Access control devices:
- A. Card reader and voice intercom; pedestal-mounted – Per Owner access control scope.
    - 1. Coordinate in-contract installation of items included, not limited to conduit, junction boxes, power supply.
  - B. Plug in type vehicle detectors for free egress loop; plug in type vehicle detectors for vehicle obstruction loop.
    - 1. As indicated on drawings; configuration, location, and installation per manufacturer recommendation.

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2. Loop wire: 16 or 18-gauge, XLPE or XHHW-2 which is rated for both wet and dry environments.
- C. Emergency vehicle open devices:
1. Knox box – re-use existing box, mount to new housing.
- 2.5 Optional alert devices: Flashing lights. Configurable audible beacon included as standard.
- 2.6 Other options:
- A. Heater with thermostat control for cold or damp climates or for use with biodegradable hydraulic oil.
  - B. 5"x7" nominal single piece aluminum arm with integrated LED lights on both sides for 16' clear opening.
  - C. One additional traffic light for opposite facing direction.
  - D. 208/230 VAC single phase and 208/230/460 VAC three phase; refer to electrical design documents and field-verify.
  - E. UPS AC battery backup for systems up to 1 hp or VFD equipped. 208/230 VAC single phase only.

### **PART 3 FACTORY TESTING**

- 3.1 Fully assemble and test, at the factory, each barrier to assure smooth operation, sequencing and electrical connection integrity.
- 3.2 Inspect and test all hydraulics are leak free.
- 3.3 Maintain records of material and process traceability for all critical structural elements.
- 3.4 Check all mechanical connections for tightness and alignment. Check all welds for completeness and continuity.
- 3.5 Inspect finishes for completeness. Touch up imperfections prior to shipment.
- 3.6 Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

### **PART 4 EXECUTION**

VEHICLE BARRIER SYSTEMS

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#### 4.1 PREPARATION

- A. Install temporary concrete barriers to maintain vehicular security during construction.

#### 4.2 INSTALLATION

- A. Install vehicle barrier systems in accordance with manufacturer's instructions and the authorities having jurisdiction.

#### 4.3 FIELD TESTING AND COMMISSIONING

- A. General: Vehicle barrier system shall be initially started and commissioned by a certified manufacturer-authorized field service technician. Perform tests in accordance with the manufacturer's instructions.
- B. Facility Electrical Power: Verify all wiring terminations before turning on electrical power. Verify voltage from facility electrical power feed.
- C. Initial Barrier Operation: Cycle vehicle barrier to raise and lower the barrier and ensure proper, smooth operation.
  - 1. Correct and repair operational anomalies, failures, malfunctions and/or other equipment trouble for proper operation.
  - 2. Make adjustments required for the proper operation of the overall vehicle barrier system specific to site conditions.
  - 3. Verify all functions, control, monitoring, indications of all integrated equipment is properly operating as a system.
  - 4. Verify hydraulic circuits and connections to ensure that they are leak-free, and correct any leaks found.

#### 4.4 FIELD TESTING

- A. Upon completion of installation and commissioning perform a site field test on each equipment piece and the overall vehicle barrier system.
  - 1. Test the vehicle barrier system shall not be tested until the system is commissioned, and fully operational.
  - 2. Raising and lowering the equipment, both electrically and manually, through their complete range of operation.
  - 3. Verify the amount of time to raise and lower the bollards.
  - 4. Cycle each set of bollards using the specified duty cycle for not less than 30 minutes, to test for heat build-up in the hydraulic system.
  - 5. Verify no less than 10 operations of the EFO function.
  - 6. Verify the use of all operator control panel functions and indicators.
  - 7. Verify operation of any installed equipment directly operated by the vehicle barrier system, including accessories.

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- B. Submit a Test Report with test data verified by the manufacturer to the Architect after completion of field testing.

4.5 FIELD TRAINING

- A. Provide manufacturer's on-site field-training for owner operators and service technicians operations sequence and suggested/required maintenance to maintain warranty.

END OF SECTION 11 12 50

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## **SECTION 11 61 50 – LABORATORY 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. Section Includes:

- 1. Steam Sterilizers

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. Shop Drawings: Show overall dimensions, utility service connection locations and consumptions, wall opening sizes and relationships to adjoining construction.
- C. Product Schedule: For laboratory equipment. Use same designations indicated on Drawings.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Warranties: Sample of special warranties.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of laboratory equipment to include in operation and maintenance manuals.

#### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.



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- B. Regulatory Requirements: Comply with the following:
1. ASME Code for Pressure Vessels: Provide sterilizer units that comply with Section VIII, Division 1 and is pressure rated for 45 PSIG.

## PART 2 PRODUCTS

### 2.1 LABORATORY STERILIZER SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
1. Getinge USA.
  2. Primus Sterilizer Company.
  3. Steris Corporation.
  4. Tuttnauer.
  5. Or equal if and as specifically approved by Architect by Addendum during the bidding period.
- B. Steam Sterilizer
1. Basis-of-Design Product: Primus Sterilizer Company, Model PSS5-B-MSSD.
  2. Chamber Dimensions: 20 inches wide, 20 inches high, 38 inches deep.
  3. Configuration: Cabinet, Double Door, smooth hydraulic operation without pulleys, cables or motors.
  4. Construction
    - a. General: Enamel coated steel frame with adjustable legs. Vessel insulated with 1" semi-rigid high temperature fiberglass insulation.
    - b. Fascia and Side Panels: Constructed of 16-gauge, type 304 stainless steel, removable for service.
    - c. Door: Vertically operating door. Provide with interlock system to prevent cycle start unless door is fully closed and secured.
  5. Controls: Microcomputer controller with 8 separate programs for sterilization. Cycle parameters shall be programmable by the user. Process parameters are displayed and recorded. Provide side mounted control panel with printing capability.
  6. Electrical Service: 120V; 1 phase (See Electrical).
  7. Cycles: Manufacturer's standard gravity, vacuum and liquid cycles and vacuum water ejector option.
  8. Compressed air to gasket: House compressed air provided.
  9. Steam Source: House steam provided.
  10. Bio-seal: Provide silicone rubber gasket seal to wall construction on load (dirty) side of equipment.
  11. Loading Equipment:
    - a. Include 1 Transfer Carriage and 1 Loading Cart for each unit shown.
  12. Warranty: 1 Year Parts & Labor, 15 Years on Chamber/Pressure Vessel.

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## 2.2 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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 and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

### 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting construction with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Comply with plumbing and electrical requirements.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

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1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. **Tests and Inspections:**

1. Perform visual, mechanical, and electrical inspection and testing for each piece of laboratory equipment according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. **Leak Test:** After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. **Operational Test:** After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. Laboratory equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 **DEMONSTRATION**

- A. Engage a factory-authorized service representative to perform startup and validate operational functions and train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 11 61 50

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## **SECTION 21 05 00 - BASIC FIRE PROTECTION REQUIREMENTS**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. This section describes Basic Fire Protection Requirements required to provide for a complete installation of all fire protection systems for this project. This section shall apply to all other Division 21 specification sections as well as all work shown on the drawings.
- B. It is the intent of the Fire Protection Division of the Specifications that all mechanical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.
- C. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative and the Authority Having Jurisdiction.
- D. The Contractor shall note that, in some cases, piping as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.
- E. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.

#### **1.2 RELATED SECTIONS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section and all other sections of Division 21.
- B. Commissioning requirements.
  - 1. See section 01 91 13 – General Commissioning Requirements for all commissioning requirements.

#### **1.3 DESCRIPTION OF WORK**

- A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete fire protection systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, piping, etc.

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#### 1.4 QUESTIONS OF INTERPRETATION

- A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.
- B. The Architect/Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

#### 1.5 CONTRACT DOCUMENT DISCREPANCIES

- A. If any ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of bid.
- B. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of three-dimensional objects. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies should be 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.
- C. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of materials or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.
- D. If there is a conflict between manufacturer's recommendations and the Contract Documents, the manufacturer's recommendations shall govern with no additional cost to the Owner.
- E. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor.

#### 1.6 QUALITY ASSURANCE

- A. Installers shall have at least 5 years of successful installation experience on projects with fire

BASIC FIRE SUPPRESSION REQUIREMENTS

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protection installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation, unless noted otherwise in other fire protection sections.

- B. Manufacturer of equipment and materials must be regularly engaged in the manufacture of the specified equipment and material with similar construction and capacities and whose products have been in satisfactory use in similar service for not less than five (5) years, unless noted otherwise in other Fire Protection Sections.
- C. Qualify welding processes and operators for structural steel according to AWS D1.1. "Structural Welding Code - Steel.
- D. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- E. Comply with provisions of ASME B31 Series "Code for Pressure Piping", including all addenda.
- F. Comply with provisions of NFPA 13, NFPA 14, and NFPA 24, including all addenda.
- G. Contractor signed welder certificate(s) shall be submitted. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current. A record shall be maintained on the job site showing the date and results of qualification tests for each welder employed on the job. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner's representative.

## 1.7 REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall, at minimum, conform to the following as applicable:
  - 1. Safety and Health Regulations for Construction.
  - 2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
  - 3. ACGIH - American Conference of Governmental Industrial Hygienists.
  - 4. AIHA - American Industrial Hygiene Association.
  - 5. AMCA - Air Movement and Control Association.
  - 6. ANSI - American National Standards Institute.
  - 7. ASA - Acoustical Society of American.
  - 8. ASHRAE - American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
  - 9. ASME - The American Society of Mechanical Engineers.
  - 10. ASTM - American Society of Testing and Materials.
  - 11. CAGI - Compressed Air and Gas Institute.
  - 12. CTI - Cooling Tower Institute.
  - 13. EJMA - Expansion Joint Manufacturers Association.
  - 14. ETL - Engineering Tests Laboratory.

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15. HI - Hydraulic Institute.
16. HYD I - Hydronics Institute.
17. ICBO - International Conference of Building Officials.
18. ICC – International Code Council.
19. NEBB - National Environmental Balancing Bureau.
20. NEC - National Electrical Code.
21. NEMA - National Electrical Manufacturers Association.
22. NFPA - National Fire Protection Association.
23. NSF - National Sanitation Foundation.
24. SAE - Society of Automatic Engineers.
25. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
26. TEMA - Tubular Exchanger Manufacturers Association.
27. UL - Underwriters Laboratories, Inc.
28. International Plumbing Code.
29. International Mechanical Code.
30. NIH DRM – National Institute of Health Design Requirements Manual
31. Other governing, state, and local codes that apply.

1.8 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Sections "General Conditions" and "Special Conditions".
  1. **See Section 21 13 13 for special submittal procedures for sprinkler/standpipe system submittals.**
- B. The Architect/Engineer's review of submittals, including any corrections or comments made on the shop drawings during the review process, do not relieve Contractor from compliance with requirements of the Contract Documents. The review is only a review of general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication process and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data or samples by the Architect/Engineer's review of those drawings.
- C. No portion of the work requiring submission of a shop drawing, product data or sample shall be commenced until the submittal has been reviewed by the Architect/Engineer. All such portions of the work shall be in accordance with reviewed submittals and the associated manufacturer recommendations.
- D. Shop drawings shall include the minimum following information as applies. Additional specific information required is outlined in other Fire Protection Sections.
  1. Certified performance and data with system operating conditions indicated.
  2. All equipment items shall be marked with the same item number as used on drawings or

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- schedules.
3. **Product Data:** Submit manufacturer's technical product data, including rated capacities of selected model clearly indicating, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.
  4. **Shop Drawings:** Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances, and methods of assembly of components.
  5. **Wiring Diagrams:** Submit manufacturer's electrical requirements for power supply wiring to electrical equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  6. **Maintenance Data:** Submit maintenance data and parts list for each fire protection equipment, control and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.9 SUBSTITUTES

- A. Refer to the General Conditions and Special Conditions sections of this Specification for general substitution requirements and information.

1.10 WARRANTY

- A. Refer to the General Conditions section of this Specification for general warranty requirements and information. Additional warranty requirements are specified in subsequent Fire Protection Sections.

1.11 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Operate each system and item of equipment in a test run of appropriate duration, but no less than 7 days, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Systems shall not be used for temporary operation during construction without written approval from the Architect/Engineer and the Owner Representative. If approved and used during construction, all systems must be properly maintained and operated according to manufacturer recommendations. Immediately prior to turnover to the Owner, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.
- C. Any system placed in temporary operation for testing during construction shall be properly maintained and operated by the Contractor.
- D. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.



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- E. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.
- F. All tests shall be made after notification to and in the presence of the Owner's representative.
- G. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.
- H. After systems have been demonstrated to be satisfactory for 7 consecutive days and ready for permanent operation, all permanent pipe line strainers shall be cleaned, valve and packings properly adjusted, lubrication checked and replenished if required. Temporary piping, etc. shall be removed and openings restored in a permanent manner acceptable to the Owner's representative.
- I. Conduct a walk-through instruction seminar for the Owner's personnel pertaining to the continued operation and maintenance of fire protection equipment and systems. Explain the identification system, maintenance requirements, operational diagrams, temperature control provisions, sequencing requirements, security, safety, efficiency and similar features of the systems. Walk through must be documented as to those attending and subjects covered. Walk through document(s) shall be signed and dated by the contractor's representative and the owner's representative.
- J. At the time of substantial project completion, turn over the prime responsibility for operation of the fire protection equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.
  - 1. If any systems are operated prior to substantial completion, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.

1.12 AS-BUILT DOCUMENTS

- A. Prepare as-built documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in above, indicate the following installed conditions:
  - 1. The Fire Protection Contractor shall provide the Owner with as-built drawings for pipe mains and branches, size and location, for both exterior and interior; locations of control valves and supervisory switches; drain valves; and indicate all devices requiring periodic maintenance or repair.
  - 2. All fire protection systems as described in the Specifications and/or shown on the drawings.
  - 3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located. Valve location diagrams, complete with valve tag chart. Refer to Division 21 Section "Fire

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- Protection Identification." Indicate actual inverts and horizontal locations of underground piping.
4. Equipment/material locations (exposed and concealed), dimensioned from prominent building lines.
  5. All items must be dimensioned in horizontal and vertical plans to allow Architect/Engineer to update Building Information Model (BIM) file for Owner.

1.13 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  4. Servicing instructions and lubrication charts and schedules.

**2. PRODUCTS (NOT APPLICABLE)**

**3. EXECUTION**

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her 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 his or her 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.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Store and handle material and equipment in compliance with manufacturers' recommendations

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to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

- C. Use proper lifting equipment where size/weight requires handling by such means.
- D. Comply with manufacturer's rigging and moving instructions for unloading material and equipment, and moving them to final location.
- E. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.
- F. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- G. Fire Protection Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.
- H. Any material that is damaged during delivery, storage, handling, or installation shall be brought to the attention of the Architect/Engineer for review of its acceptability in the project.
  - 1. The Architect/Engineer shall be the sole and final judge as to the suitability of damaged items.

### 3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

### 3.4 COORDINATION

- A. Sequence, coordinate, and integrate installations of fire protection materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- B. Coordinate the fire protection work with work of the different trades so that:
  - 1. Interferences between fire protection, mechanical, electrical, architectural, and structural work, including existing services, will be avoided.
  - 2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of fire protection and other equipment will be provided.
  - 3. All Contractors shall establish utility elevations prior to fabrication and shall coordinate

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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. Equipment requiring access, including terminal units, fire/smoke dampers, and piping valves.
  - d. Ductwork.
  - e. Electrical busduct.
  - f. Electrical cable trays, including access space.
  - g. Piping (hydronic and plumbing).
  - h. Sprinkler/standpipe piping.
  - i. Electrical conduits and wireway.
4. Pipes, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

### 3.5 FIRE PROTECTION INSTALLATIONS

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.
- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.
- D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for fire protection installations.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
- F. Coordinate connection of fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

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- G. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
- H. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- I. Install fire protection equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Welding, sweating, or brazing operations
  - 1. All cutting, welding, brazing, or sweating operations carried on in the vicinity of, or accessible to, combustible material shall be adequately protected to make certain that a spark or hot slag does not reach the combustible material and start a fire.
  - 2. When it is necessary to do cutting, welding, brazing, or sweating close to wood construction, in pipe shafts, or other locations where combustible materials cannot be removed or adequately protected, employ fireproof blankets and proper fire extinguishers. Position another individual nearby to guard against sparks and fire.
  - 3. Whenever combustible material has been exposed to molten metal or hot slag from welding or cutting operations, or spatter from electric arc operations, a guard shall be kept at the place of work for at least one hour after completion to verify that smoldering fires have not been started.
  - 4. Whenever welding or cutting operations are carried on in a vertical shaft or where floor openings exist, a fire guard shall be employed to examine all floors below the point of the welding or cutting operation. The fire guard shall be kept on duty for at least one hour after completion to verify that smoldering fires have not been started.
  - 5. Before any work involving cutting, welding, brazing, or sweating operations is started, consult with the Architect/Engineer as to particular safety precautions to be employed on the work.

### 3.6 ACCESSIBILITY

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

### 3.7 LUBRICATION AND TOOLS

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- A. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's representative prior to final acceptance of the equipment.

### 3.8 START-UP

#### A. PIPING SYSTEMS PRESSURE TESTING

1. The following personnel in the order listed shall be considered acceptable witnesses of all piping pressure testing:
  - a. Owner's Representative
  - b. Mechanical Engineer / Architect
  - c. General Contractor's Foreman
2. Removal of pressure charge and associated drain down shall also be witnessed.
3. Fire protection contractor shall provide a minimum of 24-hour notice to at least one of the above listed parties before commencing any piping systems pressure test.
4. Pressure gauge requirements: Provide recently calibrated gauge with 4" face and a range such that test pressure is between 50% and 100% of gauge range. For example, a gauge with a 15 psig range is acceptable for a 10 psig pressure test, whereas a gauge with a 30 psig range is unacceptable in this application. Gauge resolution shall be suitable for type of testing, system size and test media. Gauge shall have been recently calibrated.
5. All piping pressurizing equipment (i.e., air compressor) shall be disconnected before test is commenced and shall remain disconnected for the entire duration of the test.
6. Entire system shall be properly vented before test is commenced.
7. For specific piping pressure testing requirements and procedures, see applicable piping systems specification sections. At minimum, however, pipe systems should be tested at the following pressures and all installed components must be rated at this pressure at the actual operating temperature:
  - a. Sprinkler and/or standpipe piping                      200 psig
8. Submit completed "Pipe Pressure Test Log" provided at the end of this Section for each pressure test before final project closeout. Test log shall also be included in operation and maintenance manuals.

**NOTE: USE MULTIPLE FORMS IF NECESSARY**

END OF SECTION 21 05 00

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**PIPE PRESSURE TEST LOG**

PROJECT:

BUILDING:

GENERAL CONTRACTOR:

CLARK ENERSEN PROJECT NUMBER:

MECHANICAL CONTRACTOR:

TEST INFORMATION						TEST PRESSURE					
TEST DATE	PIPI NG SYS TEM	AREA TESTED	TEST MEDIA (WATER OR AIR)	TEST DURATION (MINUTES)	PRESSURE GAGE NUMBER	INITIAL (PSIG)	FINAL (PSIG)	TESTED BY	WITNESSED BY	PASS / FAIL (P/F)	COMMENTS

ADDITIONAL

COMMENTS:

\_\_\_\_\_

\_\_\_\_\_

**PRESSURE GAGE INFORMATION**

GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE	GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE

**NOTE: USE MULTIPLE FORMS IF NECESSARY**



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**SECTION 21 05 29 – FIRE PROTECTION HANGERS AND SUPPORTS**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers, supports, anchors, saddles and shields.
- B. Sleeves and seals.
- C. Sealants, firestop insulation, putty and compounds.

1.2 REFERENCE SECTION 21 05 00 FOR THE FOLLOWING:

- A. Commissioning requirements.
  - 1. See section 01 91 13 – General Commissioning Requirements for all commissioning requirements.
- B. REFERENCES
  - 1. NFPA 13, 14, and 24.
  - 2. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, and Manufacture.
  - 3. MSS SP-69 – Pipe Hangers and Supports – Selection and Application.
  - 4. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

C. SUBMITTALS

D. DELIVERY, STORAGE, AND HANDLING

**2. PRODUCTS**

2.1 PIPE HANGERS AND SUPPORTS

- A. Fire Protection and Standpipe Piping:
  - 1. Conform to International Fire Code, NFPA 13, NFPA 14, NFPA 24, MSS SP58, MSS SP69 and MSS SP89, as applicable.
- B. Hangers and Supports:
  - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch, Carbon steel, adjustable swivel, band type.

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2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
5. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
6. Vertical Support: Steel riser clamp.
7. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
9. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
10. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
11. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
12. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
13. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
14. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
15. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
16. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
17. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
18. Side-Beam Brackets (MSS Type 34): For sides of steel beams.
19. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
20. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

## 2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

## 2.3 INSERTS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Internally Threaded Screw Anchors: Internally threaded, self tapping screw anchors, Power Fasteners Snake or approved equivalent.
  1. Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI318 (Strength Design method using Appendix D)

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## 2.4 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

## 2.5 SEALANTS, FIRESTOP INSULATION, PUTTY, AND COMPOUNDS

- A. Firestopping Insulation: Glass fiber type, non-combustible, UL listed.
- B. Firestop Putty: Non-hardening, non shrinking, UL listed.
- C. Firestop Compounds: Cementitious material, non-shrinking, UL listed.
- D. Sealants:
  - 1. Non fire/smoke rated partitions: Acrylic or silicone based caulking.
  - 2. Fire/smoke rated partitions: Silicone based caulking, UL listed.

## 3. EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 13, 14, and 24.

### 3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

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- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### 3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Support fire protection systems piping independently from other piping systems. Fire main piping may be trapezed with other piping systems. Coordinate trapeze hangers with the Division 21 Contractor and other trades.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for non-insulated copper pipe.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat steel hangers and supports in the mechanical room and other exposed areas. Refer to the Architectural reflected ceiling plans for location of exposed ceilings. Hangers and supports located in attic space, crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Adjust hangers to distribute loads equally on attachments and to achieve specified pipe slopes.

### 3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrate weather or waterproofed walls and floors.

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- B. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

### 3.5 SLEEVES

- A. Provide pipe and duct sleeves at all fire/smoke rated partitions, exterior wall penetrations and wall penetrations into exposed areas. Pipe sleeves are not required for penetrations through non-rated concealed partitions.
- B. At the Contractor's option, pipe sleeves may be omitted if the wall or floor is core drilled, except in areas potentially exposed to wet conditions (such as mechanical rooms, loading dock, generator room, penthouse, kitchen, etc.).
- C. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Sleeves through floors shall be grinded flush with finish floor level. In areas potentially exposed to wet conditions (such as mechanical rooms, loading dock, generator room, penthouse, kitchen, etc.), sleeve shall extend a minimum of 2" above finish floor.
- F. Where piping penetrates non-rated ceilings or walls, close off space between pipe and adjacent work with urethane rod stock and caulk air tight.
- G. Seal pipe penetrations through non-rated floors.
  - 1. Where piping is not located in a rated shaft and it penetrates a single non-rated floor, close off space between pipe and adjacent work with urethane rod stock and caulk air tight.
  - 2. Where piping is not located in a rated shaft and it penetrates multiple non-rated floors, close off space between pipe and adjacent work with appropriate fire-rated sealant, insulation, putty, or compound.
- H. Where piping penetrates rated floor, ceiling, or wall, close off space between pipe or duct with appropriate fire rated sealant, insulation, putty or compound. Refer to the Drawings for fire/smoke rated wall locations and the appropriate ratings.
- I. Install chrome plated steel escutcheons on piping at finished surfaces.

### 3.6 HANGER SCHEDULES

- A. Reference International Fire Code, NFPA 13, and NFPA 14 where applicable.

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**SECTION 21 05 53 – FIRE PROTECTION IDENTIFICATION**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Tags.
- B. Pipe Markers.
- C. Ceiling Tacks/Stickers.

1.2 REFERENCE SECTION 21 05 00 FOR THE FOLLOWING:

- A. Commissioning requirements.
  - 1. See section 01 91 13 – General Commissioning Requirements for all commissioning requirements.
- B. REFERENCES
- C. RELATED SECTIONS
- D. SUBMITTALS
- E. QUALITY ASSURANCE
- F. PROJECT RECORD DOCUMENTS
  - 1. Record actual locations of tagged valves.

**2. PRODUCTS**

2.1 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. Chart: Typewritten list that is plastic laminated and mounted in mechanical room. Valve list is to coordinate with mechanical piping schematics if provided on plans.



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- C. Pipe Schematics: Valve numbers are to be labeled on Engineer schematic drawings, plastic laminated and schematic shall be mounted in mechanical room.

## 2.2 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings; minimum information indicating flow direction arrow and identification of fluid being conveyed.

## 2.3 CEILING TACKS/STICKERS

- A. Description: ½” self adhesive color coded stickers.
- B. Color code as follows:
  - 1. Red - Fire dampers/smoke dampers, sprinkler/standpipe system valves

## 3. EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install tags with corrosion resistant chain.
- B. Install plastic tape pipe in accordance with manufacturer's instructions. Directional arrow tape shall be overlapped to ensure proper adhesion and no peeling of tape in future.
- C. Identify hose connections cabinets and drain termination points with plastic nameplates.
- D. Identify valves in main and branch piping with tags.
- E. Identify piping, concealed or exposed, with plastic tape pipe markers. For pipes ¾” and smaller, identify piping with tags. Identify service, flow direction, and pressure when applicable, i.e. low pressure steam, high pressure steam. Install in clear view from floor and align with axis of piping. Locate identification not to exceed 15 feet on straight runs including risers and drops, more often in congested areas, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Provide a minimum one label per pipe per room. Where pipes are racked, install pipe markers on each pipe in the same location to aid in differentiating each pipe in the rack.

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- F. Provide ceiling stickers or machine generated labels to locate valves, switches, etc. above lay-in type panel ceilings. Locate ceiling sticker on the ceiling grid closest to equipment. Label each sticker with the device located above the ceiling, i.e. 2<sup>nd</sup> Floor Zone Valve.

END OF SECTION 21 05 53

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## **SECTION 21 13 13 - FIRE PROTECTION SYSTEM**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Pipe, fittings, valves, and connections for an automatic wet-pipe sprinkler system.
- B. System design, installation, and certification.

#### **1.2 REFERENCE SECTION 21 05 00 FOR THE FOLLOWING:**

- A. Commissioning requirements.
  - 1. See section 01 91 13 – General Commissioning Requirements for all commissioning requirements.

#### **B. REFERENCES**

- 1. NFPA 13 - Installation of Sprinkler Systems.
- 2. NFPA 14 – Installation of Standpipe and Hose Systems.
- 3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances

#### **C. PROJECT RECORD DOCUMENTS**

- 1. Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

#### **D. OPERATION AND MAINTENANCE DATA**

#### **E. DELIVERY, STORAGE, AND HANDLING**

- 1. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

#### **1.3 SYSTEM DESCRIPTION**

- A. System to provide coverage for entire building.
- B. System shall be an automatic system conforming to NFPA 14 Class I systems. Wet pipe sprinkler system conforming to NFPA 13 Ordinary Hazard – Group 2 occupancy requirements. See drawings for zoning requirements and additional information.

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- C. Interface system with building fire and smoke alarm system.
- D. Although not specifically specified, the Contractor shall provide and install all supplementary and/or miscellaneous items and devices as required for a complete, code compliant and operational sprinkler system. Design and install each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings to be submitted for approval.
- E. Discharge from individual heads in the hydraulically most remote area shall be between 100 percent and 120 percent of the specified density.
- F. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and air supply diffusers. Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for the indicated hazard occupancy.
- G. Devices and equipment for fire protection service shall be UL Fire Prot Dir listed or FM P7825 approved for use in wet pipe sprinkler systems.
- H. Calculate losses in piping in accordance with the Hazen-Williams formula with 'C' value of 120 for steel piping.
- I. Only new equipment and pipe shall be used. All equipment shall be UL listed and FM approved.

#### 1.4 SUBMITTALS

- A. Shop Drawings: Prepare Minimum 24 by 36 inch detail working drawings of sprinkler heads and piping system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams. Submit drawings including the hydraulic calculations signed and stamped by a registered fire protection engineer licensed in the state of Missouri.
- B. Product Data: Provide data on sprinkler heads, valves, and specialties, including manufacturer's catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections.
- C. Submit shop drawings, product data, hydraulic calculations to authority having jurisdiction (local and state Fire Marshall if required) and Owner's insurance underwriter for approval. Submit proof of approval to Architect/Engineer.

#### 1.5 QUALITY ASSURANCE

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- A. Designer and Installer: Company specializing in performing work of this Section with minimum three years experience.
- B. Sprinkler Systems: Perform work to NFPA 13 and NFPA 14. Contractor shall hydraulically calculate system pipe sizes in accordance with NFPA 13 and NFPA 14. Calculations and design drawings shall be sealed by a licensed Professional Engineer registered in Missouri.
- C. Equipment and Components: Bear UL and FM label or marking.
- D. Valves: Bear UL and FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

1.6 REGULATORY REQUIREMENTS

- A. Hydraulic Calculations, Product Data, Shop Drawings: Bear stamp of approval of authority having jurisdiction (including Fire Marshall if required); Shall be sealed by a licensed Professional Engineer registered in Missouri.

1.7 EXTRA MATERIALS

- A. Furnish under provisions of appropriate Division 1 specification section.
- B. Provide extra sprinklers and storage cabinets under provisions of NFPA 13.
- C. Provide suitable wrenches for each head type.

**2. PRODUCTS**

2.1 SPRINKLER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53 or ASTM A795; Schedule 40 black steel.
  - 1. Steel Fittings: ANSI/ASME B16.5, steel flanges and fittings.
  - 2. Cast Iron Fittings: ANSI/ASME B16.4, screwed fittings.
  - 3. Malleable Iron Fittings: ANSI/ASME B16.3, screwed type.
  - 4. Joints: Flanged, grooved or threaded.
  - 5. Mechanical Grooved Couplings: Victaulic 005 Firelock Rigid rolled groove fittings, no equivalent. Cut grooves or O-ring type socket fittings are not allowed.
- B. Pipe hangers shall conform to NFPA standard 13 requirements and shall be FM/UL approved for use in fire sprinkler systems. Refer to specification section 21 05 29 for additional information.

2.2 GATE VALVES

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- A. Up to and including 2 Inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, solid wedge disc, threaded ends, class 175, UL/FM approved.
- B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, solid wedge disk, flanged or grooved ends, class 175, UL/FM approved.

2.3 ANGLE VALVES

- A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, screwed ends, with backseating capacity, class 175, UL/FM approved.
- B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc, class 175, UL/FM approved.

2.4 BALL VALVES

- A. Up to and including 2 Inches: Bronze two piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle threaded ends, blowout proof stem, full port, 600 WOG, UL/FM approved.
- B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged end.

2.5 BUTTERFLY VALVES

- A. Cast or ductile iron body, aluminum bronze disc, resilient replaceable EPDM seat, wafer or lug ends, extended neck, handwheel and gear drive and integral indicating device and built-in tamper proof switch rated, UL/FM approved.

2.6 CHECK VALVES

- A. Up to and including 2 Inches: Bronze swing disc, screwed ends, class 200, UL/FM approved.

- 2.7 Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged, screwed or grooved ends, UL/FM approved.

2.8 SPRINKLER SYSTEM ZONE CONTROL MODULES

2.9 DRAIN VALVES

- A. Brass ball valve with cap and chain, 3/4 inch hose thread, UL/FM approved.

2.10 SPRINKLERS

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A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
3. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. (Wrenches shall be provided by the sprinkler manufacturer that directly engage the cast wrench boss.)

B. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
3. High or *intermediate* temperature *sprinklers* heads shall be provided in all mechanical rooms, elevator equipment rooms, and emergency generator rooms, near sterilizers and elsewhere when elevated ambient temperatures might be expected.

A. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Install none-recessed sprinkler heads in all BSL-3 spaces. Install upright sprinkler heads in all areas without ceilings.

4. Ceiling Mounting: Chrome-plated steel, one piece, flat.
5. Sidewall Mounting: Chrome-plated steel one piece, flat.

B. Sprinkler Guards:

C. Escutcheons and guards shall be listed, and supplied for use with the sprinkler by the sprinkler manufacturer.

**3. EXECUTION**

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13, NFPA 14, and NFPA 24 as applicable.



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- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient. Place pipe runs to minimize obstruction to other work.
- C. Install piping to conserve building space, and not interfere with use of space and other work. It shall be the primary responsibility of sprinkler contractor to coordinate with other building trades to avoid architectural, structural, mechanical and electrical interference's. All necessary additional sprinklers, piping, and other equipment required to avoid such interferences shall be provided as part of the sprinkler contract without additional compensation after the bid is submitted. However, should a change be made in the work of other contractors or trades from that shown on the drawings which results in additional work for the sprinkler contractor, a reasonable and equitable adjustment in the contract sum may be made.
- D. Sprinkler locations shown on drawings are recommendations only. Sprinkler/standpipe design engineer shall verify and modify locations as necessary to provide a code-compliant, functional system. Sprinkler locations will be subject to review of the Owner and Architect/Engineer during the shop drawing review phase.
- E. Wherever possible, install piping as high as possible so as not to interfere with the work of others. Wherever possible, place piping in concealed spaces above finished ceilings.
- F. Group piping whenever practical at common elevations.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Slope piping and arrange systems to drain at low points.
- H. If it is discovered during installation that any component of the sprinkler system will be exposed to freezing conditions, the contractor shall notify the Architect/Engineer immediately.
- I. Prepare all exposed pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Paint to match finish of adjacent walls surfaces.
- J. Do not penetrate building structural members unless specifically indicated.
- K. Provide sleeves when penetrating footings, fire rated floors and fire rated walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- L. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Provide gate, ball or butterfly valves for shut-off or isolating service.
- O. Provide drain valves at main shut-off valves, low points of piping and apparatus.

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- P. Install equipment in accordance with manufacturer's instructions.
- Q. All sprinklers installed in lay-in ceiling tiles shall be centered within the individual ceiling tile. Contractor shall provide all swing joints and/or offsets required to accomplish center locations. Ensure sprinklers are installed level with adjacent ceiling surface.
- R. Apply masking tape or paper cover to ensure concealed sprinkler head cover plates do not receive field paint finish.
- S. Flush entire piping system of foreign matter.
- T. Install all valves, flow switches, and other accessories in accessible locations. Where these components are located in a concealed area, provide access panels.
- U. Sprinkler or standpipe piping shall not be installed above any electrical panels, electrical transformers, fire alarm panels, or EMCS panels, regardless of distance above.

3.3 FIELD QUALITY CONTROL

- A. Hydrostatically test entire system per NFPA 13 and NFPA 14. Test shall be witnessed by authority having jurisdiction.
- B. Perform a system test with a fire department pumper truck to verify acceptable pressure (typically 100 psig) at the most-remote standpipe hose connection. Connect pumper truck to fire department connection for test. Coordinate with authority having jurisdiction and local fire department.
- C. Note each test in Pipe Pressure Test Log provided in section 21 05 00 of these specifications. Submit test log to Engineer for review before final project closeout. Furnish copy of test log with operation and maintenance data.
- D. The contractor shall furnish and sign copy of Contractor's Material and Test Certificate as provided in NFPA, Section 8-1 (Figure 8-1). Submit certificate to Engineer for review before final project closeout. Furnish copy of certificate with operation and maintenance data.

END OF SECTION 21 13 13

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## **SECTION 22 05 00 - BASIC PLUMBING REQUIREMENTS**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. This section describes Basic Mechanical Requirements required to provide for a complete installation of all mechanical systems for this project. This section shall apply to all other Division 22 specification sections as well as all work shown on the drawings.
- B. Plumbing demolition requirements.
- C. It is the intent of the Mechanical Division of the Specifications that all mechanical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.
- D. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative.
- E. The Contractor shall note that, in some cases, piping as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.
- F. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.
- G. Note that the words "mechanical" and "plumbing" are used interchangeably throughout the Division 22 and 23 specification sections.

#### **1.2 RELATED SECTIONS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section and all other sections of Division 22.

#### **1.3 DESCRIPTION OF WORK**

- A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete mechanical systems required by these specifications and/or shown on the drawings of the contract.

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- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, piping fixtures, etc. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.

#### 1.4 QUESTIONS OF INTERPRETATION

- A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.
- B. The Architect/Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

#### 1.5 CONTRACT DOCUMENT DISCREPANCIES

- A. If any ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of bid.
- B. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of three-dimensional objects. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies should be 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.
- C. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of materials or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.
- D. If there is a conflict between manufacturer's recommendations and the Contract Documents, the manufacturer's recommendations shall govern with no additional cost to the Owner.

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## 1.6 PERMITS

- A. All permits, fees, licenses, etc. required for this project shall be obtained by the Contractor.

## 1.7 QUALITY ASSURANCE

- A. Installers shall have at least 2 years of successful installation experience on projects with mechanical installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation, unless noted otherwise in other mechanical sections.
- B. Manufacturer of equipment and materials must be regularly engaged in the manufacture of the specified equipment and material with similar construction and capacities and whose products have been in satisfactory use in similar service for not less than five (5) years, unless noted otherwise in other Mechanical Sections.
- C. Qualify welding processes and operators for structural steel according to AWS D1.1. "Structural Welding Code - Steel.
- D. Quality welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- E. Comply with provisions of ASME B31 Series "Code for Pressure Piping", including all addenda.
- F. Contractor signed welder certificate(s) shall be submitted. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current. A record shall be maintained on the job site showing the date and results of qualification tests for each welder employed on the job. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner's representative.
- G. For all the refrigerant work/service required by this project, all refrigerant technicians shall be EPA/ASHRAE 34 certified for corresponding classification type I, II, III and/or IV.

## 1.8 REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall conform to the following as applicable:
  - 1. Safety and Health Regulations for Construction.
  - 2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
  - 3. ABMA - American Boiler Manufacturers Association.
  - 4. ACCA - Air Conditioning Contractors of America.
  - 5. ACGIH - American Conference of Governmental Industrial Hygienists.

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6. ADC - Air Diffusion Council.
7. AGA - American Gas Association.
8. AIHA - American Industrial Hygiene Association.
9. AMCA - Air Movement and Control Association.
10. ANSI - American National Standards Institute.
11. ARI - Air-Conditioning and Refrigeration Institute.
12. ASA - Acoustical Society of American.
13. ASHRAE - American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
14. ASME - The American Society of Mechanical Engineers.
15. ASTM - American Society of Testing and Materials.
16. BOCA – Building Officials and Code Administrators International.
17. CABO – Council of American Building Officials.
18. CAGI - Compressed Air and Gas Institute.
19. CTI - Cooling Tower Institute.
20. EJMA - Expansion Joint Manufacturers Association.
21. ETL - Engineering Tests Laboratory.
22. HEI - Heat Exchange Institute.
23. HI - Hydraulic Institute.
24. HYD I - Hydronics Institute.
25. IAPMO – International Association of Plumbing and Mechanical Officials.
26. ICBO - International Conference of Building Officials.
27. ICC – International Code Council.
28. NEBB - National Environmental Balancing Bureau.
29. NEC - National Electrical Code.
30. NEMA - National Electrical Manufacturers Association.
31. NFPA - National Fire Protection Association.
32. NSF - National Sanitation Foundation.
33. SAE - Society of Automatic Engineers.
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
35. TEMA - Tubular Exchanger Manufacturers Association.
36. UL - Underwriters Laboratories, Inc.
37. International Plumbing Code.
38. International Mechanical Code.
39. NIH DRM – National Institute of Health Design Requirements Manual
40. Other governing, state, and local codes that apply.

1.9 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Sections "General Conditions" and "Special Conditions".
- B. Shop drawings shall include the minimum following information as applies. Additional specific information required is outlined in other Mechanical Sections.
  1. Certified performance and data with system operating conditions indicated. All coil, fan, and pump performance data shall be computer generated.

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2. **Product Data:** Submit manufacturer's technical product data, including rated capacities of selected model clearly indicating, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.
3. **Shop Drawings:** Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances, and methods of assembly of components.
4. **Wiring Diagrams:** Submit manufacturer's electrical requirements for power supply wiring to electrical equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
5. **Maintenance Data:** Submit maintenance data and parts list for each mechanical equipment, control and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.10 SUBSTITUTES

- A. All proposals shall be based on providing and installing the materials or items of equipment which are hereinafter specified.
- B. **Equipment Selection:** Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing. Associated mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are to be increased accordingly, but all recommended manufacturer clearances, etc., are to be maintained within the allotted mechanical spaces. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- C. Where the terms "or equivalent" is used, the Contractor may substitute alternate equipment, materials, etc. subject to review by the Architect/Engineer and the Owner's representative during the submittal phase of the project.
- D. Where the term "or approved equivalent" is used, the Contractor may not substitute alternate equipment, materials, etc. unless requesting approval at least ten (10) days before the bid date. Notifications of any such approvals by the Architect/Engineer shall only be made in writing by Addendum.
- E. Where the term "no equivalent" is used, the Contractor must provide the specified or scheduled equipment, materials, etc.
- F. Final determination regarding substitutions shall be by the Architect/Engineer.

1.11 WARRANTY



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- A. Refer to the General Conditions section of this Specification for general warranty requirements and information. Additional warranty requirements are specified in subsequent Mechanical Sections.

1.12 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Operate each system and item of equipment in a test run of appropriate duration, but no less than 7 days, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Any system placed in temporary operation for testing or for the convenience of the Contractor during construction shall be properly maintained and operated by the Contractor.
- C. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.
- D. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.
- E. All tests shall be made after notification to and in the presence of the Owner's representative.
- F. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.
- G. After systems have been demonstrated to be satisfactory for 7 consecutive days and ready for permanent operation, all permanent pipe line strainers shall be cleaned, valve and packings properly adjusted, lubrication checked and replenished if required. Temporary piping, etc. shall be removed and openings restored in a permanent manner acceptable to the Owner's representative.
- H. Conduct a walk-through instruction seminar for the Owner's personnel pertaining to the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, maintenance requirements, operational diagrams, temperature control provisions, sequencing requirements, security, safety, efficiency and similar features of the systems. Walk through must be documented as to those attending and subjects covered. Walk through document(s) shall be signed and dated by the contractor's representative and the owner's representative.
- I. At the time of substantial project completion, turn over the prime responsibility for operation of the plumbing equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.

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1. If any systems are operated prior to substantial completion, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.

### 1.13 RECORD DOCUMENTS

- A. Prepare as-built documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in above, indicate the following installed conditions:

1. The Plumbing Contractor shall provide the Owner with as-built drawings for ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units and indicate all devices requiring periodic maintenance or repair, such as control power transformers, LACS panels/routers, field controllers, duct static pressure sensors, piping pressure sensors, etc.
2. All plumbing systems as described in the Specifications and/or shown on the drawings.
3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 22 Section "Plumbing Identification." Indicate actual inverts and horizontal locations of underground piping.
4. Equipment/material locations (exposed and concealed), dimensioned from prominent building lines.
5. All items must be dimensioned in horizontal and vertical plans to allow Architect/Engineer to update Building Information Model (BIM) file for Owner.

### 1.14 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

- B. Provide electronic copies, preferably in Adobe Acrobat Portable Document Format (pdf), of all maintenance manuals to Temperature Control Contractor for use in EMCS front-end system. Provide data in file types compatible with EMCS.

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**2. PRODUCTS (NOT APPLICABLE).**

**3. EXECUTION**

**3.1 PLUMBING DEMOLITION**

- A. Refer to Division 02 Sections for selective demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components specified under Division 22 and as indicated on the drawings.
  - 1. Controls
  - 2. Demolition related to others areas that must remain on line.
  - 3. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 4. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality. Refer to specific system specification for product information.

**3.2 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Store and handle material and equipment in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Use proper lifting equipment where size/weight requires handling by such means.
- D. Comply with manufacturer's rigging and moving instructions for unloading material and equipment, and moving them to final location.
- E. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.

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- F. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- G. Plumbing Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

### 3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

### 3.4 COORDINATION

- A. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- B. Coordinate the plumbing work with work of the different trades so that:
  - 1. Interferences between mechanical, electrical, architectural, and structural work, including existing services, will be avoided.
  - 2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of mechanical and other equipment will be provided.
  - 3. Pipes, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

### 3.5 PLUMBING INSTALLATIONS

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.

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- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.
- D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for mechanical installations.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- G. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
- H. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- I. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Welding, sweating, or brazing operations
  - 1. All cutting, welding, brazing, or sweating operations carried on in the vicinity of, or accessible to, combustible material shall be adequately protected to make certain that a spark or hot slag does not reach the combustible material and start a fire.
  - 2. When it is necessary to do cutting, welding, brazing, or sweating close to wood construction, in pipe shafts, or other locations where combustible materials can not be removed or adequately protected, employ fireproof blankets and proper fire extinguishers. Position another individual nearby to guard against sparks and fire.
  - 3. Whenever combustible material has been exposed to molten metal or hot slag from welding or cutting operations, or spatter from electric arc operations, a guard shall be kept at the place of work for at least one hour after completion to verify that smoldering fires have not been started.

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4. Whenever welding or cutting operations are carried on in a vertical shaft or where floor openings exist, a fire guard shall be employed to examine all floors below the point of the welding or cutting operation. The fire guard shall be kept on duty for at least one hour after completion to verify that smoldering fires have not been started.
5. Before any work involving cutting, welding, brazing, or sweating operations is started, consult with the Architect/Engineer as to particular safety precautions to be employed on the work.

### 3.6 ACCESSIBILITY

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

### 3.7 LUBRICATION AND TOOLS

- A. Provide a fresh charge of lubricant in accordance with manufacturer's recommendations to all equipment requiring lubrication prior to start-up and maintain lubrication as required until acceptance by Owner.
- B. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's representative prior to final acceptance of the equipment.

### 3.8 PIPING SYSTEMS PRESSURE TESTING

- A. The following personnel in the order listed shall be considered acceptable witnesses of all piping pressure testing:
  1. Local Authority Having Jurisdiction
  2. Owner's Representative
  3. Mechanical Engineer / Architect
  4. General Contractor's Foreman
- B. Removal of pressure charge and associated drain down shall also be witnessed.
- C. Mechanical contractor shall provide a minimum of 24-hour notice to at least one of the above listed parties before commencing any piping systems pressure test.
- D. Pressure gauge requirements: Provide recently calibrated gauge with 4" face and a range such that test pressure is between 50% and 100% of gauge range. For example, a gauge with a 15 psig range is acceptable for a 10 psig pressure test, whereas a gauge with a 30 psig range is unacceptable in this application. Gauge resolution shall be suitable for type of testing, system size and test media. Gauge shall have been recently calibrated.

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- E. All piping pressurizing equipment (i.e., air compressor) shall be disconnected before test is commenced and shall remain disconnected for the entire duration of the test.
- F. Entire system shall be properly vented before test is commenced.
- G. For specific piping pressure testing requirements and procedures, see applicable piping systems specification sections.
- H. Submit completed "Pipe Pressure Test Log" provided at the end of this Section for each pressure test before final project closeout. Test log shall also be included in operation and maintenance manuals.

**NOTE: USE MULTIPLE FORMS IF NECESSARY**

3.9 GENERAL CONTRACTOR - MECHANICAL EXTENT OF WORK

A. Access Panels

- 1. Furnish and install panels for access to valves and dampers and similar items where no other means of access, such as readily removable, sectional ceiling is shown or specified.
- 2. The plans indicate the location of all anticipated access panels. The Division 22 Contractor shall make every effort to locate all material and equipment requiring service and maintenance above accessible ceilings or utilize the indicated access panels. Material and equipment requiring service and maintenance that is shown above inaccessible ceilings shall be relocated to accessible or exposed areas whenever possible. When these items are located in exposed areas, the Division 22 Contractor is to verify with the Architect/Engineer that the installation will not affect the aesthetics of the building. However, when it is not possible to locate these items in accessible or exposed areas due to the configuration of the actual installation of the mechanical and other trade systems or aesthetic reasons, additional access panels shall be provided. The contractor shall be equitably compensated for the additional access panels.
- 3. Refer to Section 08 31 13 – Access Doors and Panels for specific information on type and size of panels

B. Cutting and Patching

- 1. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
- 2. The Division 22 Contractor shall coordinate all cutting and patching of holes, in existing building and new construction which are required for the passage of mechanical work.

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3. Division 22 Contractor is to notify the General Contractor prior to submitting his bid, the number, size and location of all cutting and patching requirements. The Division 22 Contractor shall be liable for all associated costs of cutting and patching for mechanical work upon failure to notify the General Contractor prior to bid submission.
4. Under no circumstances shall any structural members, load-bearing walls or footings be cut without first obtaining written permission from the Engineer.
5. Cut, channel, chase and core drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
6. Patching of concrete openings shall be filled with grout and finished smooth with the adjacent surface.
7. All below-grade openings for pipe shall be sealed with interlocking synthetic rubber line assembly, Link-Seal by Thunderline Corporation or equal.
8. **All penetrations through the walls, floor, or structure of laboratory spaces, laboratory support spaces, lecture halls, classrooms, conference rooms, corridors or other areas in which relative pressurization relationships are important shall be sealed airtight. Refer to the drawings for additional information regarding rooms in which maintaining pressurization is important.**
9. Repair cut surfaces to match adjacent surfaces.
10. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
  - a. Uncover work to provide for installation of ill-timed work.
  - b. Remove and replace defective work.
  - c. Remove and replace work not conforming to requirements of the Contract Documents.
  - d. Remove samples of installed Work as specified for testing.
  - e. Install equipment and materials in existing structures.
  - f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Roof curbs, roof support for mechanical equipment and roof penetrations.

1. Division 22 Contractor is to coordinate with the General Contractor all roof curb and roof supports supplied, number, size and location of all roof penetrations. All major roof penetrations are shown on the architectural roof plan. General Contractor shall be notified of all additional roof penetrations provided by the Division 22 Contractor not shown on this plan. The General Contractor shall provide all roof deck mounted equipment and pipe supports, pipe penetrations and cut roof deck for pipe and duct penetrations, unless noted otherwise. The Division 22 Contractor shall furnish all roof curbs and the General Contractor shall install, unless noted otherwise. The Division 22 Contractor shall provide all roof covering/membrane mounted equipment and pipe supports and roof drains, unless noted otherwise.
2. The Division 22 Contractor shall be liable for all associated costs to install the roof curbs, roof supports and roof penetrations not shown on the roof plan or added after the roof system has been installed. Coordinate with the General Contractor prior to construction the number size and location of all roof penetrations.



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3. Division 22 Contractor is to coordinate with the General Contractor all roof curb and roof supports supplied, number, size and location of all roof penetrations. All major roof penetrations are shown on the architectural roof plan. General Contractor shall be notified of all additional roof penetrations provided by the Division 22 Contractor not shown on this plan.

D. Painting

1. The General Contractor is to field paint mechanical equipment and materials in specified areas as noted on the mechanical plans, mechanical schedules and in the specifications. Division 22 Contractor is to coordinate the painting of these items with the General Contractor. The Mechanical Contractor is to provide materials in these areas that are suitable for accepting paint. The clean and preparation of the materials to reach paint is the responsibility of the General Contractor unless noted specifically to be responsibility of the Division 22 Contractor.
2. In concealed locations, field-fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed and shall be painted with one coat of zinc rich paint.
3. In exposed locations, field-fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed and shall be painted in accordance with Section 09 91 00.

3.10 ELECTRICAL-PLUMBING EXTENT OF WORK

- A. The responsibility of work specified under Division 22 and 26 is clarified under, Section 22 05 13, "Electrical Requirements for Plumbing Equipment. Division 22 Contractor is to coordinate all electrical requirements prior to ordering powered plumbing equipment.

END OF SECTION 22 05 00

**PIPE PRESSURE TEST LOG**

PROJECT:

BUILDING:

GENERAL CONTRACTOR:

CLARK ENERSEN PROJECT NUMBER:

MECHANICAL CONTRACTOR:

TEST INFORMATION						TEST PRESSURE					
TEST DATE	PIPI NG SYS TEM	AREA TESTED	TEST MEDIA (WATER OR AIR)	TEST DURATION (MINUTES)	PRESSURE GAGE NUMBER	INITIAL (PSIG)	FINAL (PSIG)	TESTED BY	WITNESSED BY	PASS / FAIL (P/F)	COMMENTS

ADDITIONAL

COMMENTS:

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**PRESSURE GAGE INFORMATION**

GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE	GAGE NUMBER	MANUFACTURER	PRESSURE RANGE	RESOLUTION	STYLE	DIAL SIZE

**NOTE: USE MULTIPLE FORMS IF NECESSARY**

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**SECTION 22 05 29 – PLUMBING HANGERS AND SUPPORTS**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers, supports, stands, anchors, saddles and shields.
- B. Sleeves and seals.
- C. Flashing and sealing equipment and pipe stacks.
- D. Sealants, firestop insulation, putty and compounds.
- E. Mechanical seals.

1.2 REFERENCES

- A. ANSI/ASME B31.1 – Power Piping.
- B. ANSI/AMSE B31.9 – Building Services Piping.
- C. MSS SP-58 – Pipe Hangers and Supports – Materials, Design, and Manufacture.
- D. MSS SP-69 – Pipe Hangers and Supports – Selection and Application.
- E. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

1.3 REFERENCE SECTION 22 05 00 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Submittals
- C. Delivery, storage and handling
- D. Quality Assurance

**2. PRODUCTS**

2.1 PIPE HANGERS AND SUPPORTS

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A. Plumbing Piping:

1. Conform to International Plumbing Code, International Fuel Gas Code, ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89 as applicable.

B. Pure Water Piping and Laboratory Waste and Vent Piping:

1. Conform to manufacturer's recommendations, MSS SP58, MSS SP69, MSS SP89, as applicable. Refer to 22 67 00 and 22 10 00 for additional information.

C. Compressed Air, Vacuum, and Laboratory Gas (Nitrogen, Argon, Helium, etc.) Piping:

1. Conform to ASME B31.9, MSS SP58, MSS SP69, MSS SP89, as applicable.

D. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

E. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

F. Hangers and Supports:

1. Hangers for Hot and Cold Pipe Sizes 1/2 to 1-1/2 Inch, Carbon steel, adjustable swivel, band type.
2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 Inches; Carbon steel, adjustable, clevis.
4. , cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Vertical Support: Steel riser clamp.

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11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
14. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
15. Hangers for insulated pipe shall be enlarged to compensate for insulation thickness so that hangers support insulation. See Section 22 07 19.
16. Roof Support for Hot and Cold Pipe: See PIPE STANDS section below.
17. **Hangers for insulated pipe shall be enlarged to compensate for insulation thickness so that hangers support insulation. See Section 22 07 19.**
18. See Section 22 05 48 for vibration isolation hangers and supports.

## 2.2 TRAPEZE PIPE HANGERS

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

## 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  2. Standard: MFMA-4.
  3. Channels: Continuous slotted steel channel with inturned lips.
  4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Internally Threaded Screw Anchors: Internally threaded, self tapping screw anchors, Power Fasteners Snake or approved equivalent.
  1. Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI318 (Strength Design method using Appendix D)

## 2.5 MISCELLANEOUS MATERIALS

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

## 2.6 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

## 2.7 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.8 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
  - 1. Waterproofing: 5 lb/sq ft sheet lead
  - 2. Soundproofing: 1 lb/sq ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet buty; compatible with roofing.

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- E. Floor Drain and Floor Sink Flashing: 40 mil thick chlorinated polyethylene (CPE), equivalent to Chloraloy.
- F. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.9 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Pipes Through Rated Floors and Walls: Schedule 40 steel pipe.

2.10 SEALANTS, FIRESTOP INSULATION, PUTTY, AND COMPOUNDS

- A. Firestopping Insulation: Glass fiber type, non-combustible, UL listed.
- B. Firestop Putty: Non-hardening, non shrinking, UL listed.
- C. Firestop Compounds: Cementitious material, non-shrinking, UL listed.
- D. Sealants:
  - 1. Non fire/smoke rated partitions: Acrylic or silicone based caulking.
  - 2. Fire/smoke rated partitions: Silicone based caulking, UL listed.

**3. EXECUTION**

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.



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- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

### 3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Support fire protection systems piping independently from other piping systems.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for non-insulated copper pipe.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat steel hangers and supports in the mechanical room and other exposed areas. Refer to the Architectural reflected ceiling plans for location of exposed ceilings. Hangers and supports located in attic space, crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Adjust hangers to distribute loads equally on attachments and to achieve specified pipe slopes.
- N. Space hangers for pure water and laboratory waste and vent systems to avoid pipe sags. Use manufacturer-recommended V-groove channel if necessary to maintain sag-free installation.

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O. Saddles, Shields and Inserts

1. Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
2. Install protective shields MSS Type 40 on cold piping that has vapor barrier. Shields shall span an arc of 180 degrees (360 degrees on trapeze hangers with U-bolt clamps) and shall have dimensions in inches not less than the following:

<u>NPS</u>	<u>LENGTH</u>	<u>THICKNESS</u>
1 through 3-1/2	12	0.048
4	12	0.060
5 & 6	18	0.060
8 through 14	24	0.075
16 through 24	24	0.105

3. Pipes 8 inches and larger shall have wood inserts.
4. Insert materials shall be at least as long as the protective shield.
5. Provide manufacturer-recommended saddles, inserts, and/or shields where cellular foam insulation is used. The removal of sections of cellular foam insulation for the purpose of pipe support is not acceptable.

P. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

Q. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

R. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

S. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

T. Fastener System Installation:

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1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- U. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- V. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- W. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- X. Install lateral bracing with pipe hangers and supports to prevent swaying.
- Y. 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.
- Z. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- AA. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- BB. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  4. Shield Dimensions for Pipe: Not less than the following:

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- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- b. NPS 4: 12 inches long and 0.06 inch thick.
- c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- f. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.4 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls and floors.
- B. Flash floor drains in floors with topping over finished areas with CPE membrane, a minimum of 12 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- C. Seal floor, shower, mop sink, etc. drains watertight to adjacent materials.
- D. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.5 SLEEVES

- A. Provide pipe and duct sleeves at all fire/smoke rated partitions, exterior wall penetrations and wall penetrations into exposed areas. Pipe and duct sleeves are not required for penetrations through non-rated concealed partitions.
- B. At the Contractor's option, pipe sleeves may be omitted if the wall or floor is core drilled, except in areas potentially exposed to wet conditions (such as mechanical rooms, loading dock, generator room, penthouse, kitchen, etc.).
- C. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Sleeves through floors shall be grinded flush with finish floor level. In areas potentially exposed to wet conditions (such as mechanical rooms, loading dock, generator room, penthouse, kitchen, etc.), sleeve shall extend a minimum of 2" above finish floor.

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- F. Where piping penetrates non-rated ceilings or walls, close off space between pipe or duct and adjacent work with urethane rod stock and caulk air tight.
- G. Seal pipe penetrations through non-rated floors.
  - 1. Where piping is not located in a rated shaft and it penetrates a single non-rated floor, close off space between pipe and adjacent work with urethane rod stock and caulk air tight.
  - 2. Where piping is not located in a rated shaft and it penetrates multiple non-rated floors, close off space between pipe and adjacent work with appropriate fire-rated sealant, insulation, putty, or compound.
- H. Where piping penetrates rated floor, ceiling, or wall, close off space between pipe or duct with appropriate fire rated sealant, insulation, putty or compound. Refer to the Drawings for fire/smoke rated wall locations and the appropriate ratings.
- I. Install chrome plated steel escutcheons on piping at finished surfaces.
- J. Waste, vent and storm pipe penetrations through the concrete floor slab shall be encased in the poured concrete slab.
- K. PVC pipe casing around the cold and hot water and gas piping shall be encased in poured concrete when penetrating the floor slab. Seal the opening between the piping and PVC casing with putty or rigid polyisocyanurate insulation plug and seal with caulking.
- L. Provide mechanical seals and sleeves through exterior wall and floor penetrations and 3 hour or higher fire rated partitions.

3.6 HANGER SCHEDULES

<b>MAXIMUM PIPE SIZE</b> Inches	<b>HANGER ROD HANGER SPACING</b> Feet	<b>DIAMETER</b> Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	14	7/8
14 and Over	20	1
PVC (All Sizes)	6	3/8

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and at Joints

- A. Reference International Plumbing Code and International Fuel Gas Code where applicable.
- B. Reference manufacturer's recommendations for pure water piping and laboratory waste and vent piping.
- C. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- D. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- F. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
  - 1. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Pipe Hangers
    - a. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
    - b. 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.
    - c. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
    - d. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
    - e. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
    - f. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.

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- g. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- h. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
- i. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- j. Vee Bottom Clevis Hanger: For suspension of flexible plastic piping, Cooper B-Line B3106 or equivalent. Include plastic pipe support channel, Cooper B-Line B3106V.

2. Pipe Clamps

- a. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
- b. 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.
- c. Wall or Ceiling Mounted Pipe Strap/Clamp (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

3. Pipe Supports

- a. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- b. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
- c. 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.
- d. Pipe Rollers (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.
- e. 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.
- f. 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.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

- 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

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2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. 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.
  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.
- L. 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-joint construction, to attach to top flange of structural shape.
  3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  5. C-Clamps (MSS Type 23): For structural shapes. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
  6. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
  7. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
  8. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel. Shall only be connected to bottom joist chord if weight is 200 lbs or less.
  9. 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.
  10. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:



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1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): For protection of pipe insulation; depth of saddle to be larger than insulation thickness. 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.
- N. 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 allow 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 allow 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 allow 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.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections.
- P. Comply with MFMA-103 for metal framing system selections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- 3.7 EQUIPMENT SUPPORTS
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

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- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.8 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.9 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.

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**SECTION 22 05 53 – PLUMBING IDENTIFICATION**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.

1.2 REFERENCE SECTION 22 05 00 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Related Sections
- C. Submittals
- D. Quality Assurance

1.3 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700
- B. Record actual locations of tagged valves.

**2. PRODUCTS**

2.1 NAMEPLATES

- A. Equipment Mark Nameplates: Laminated three-layer plastic with engraved black letters (matching equipment mark indicated on drawings) on light contrasting background color, with minimum 3/4 inch high letters.
- B. Equipment Nameplates: Factory-applied permanent nameplate indicating the manufacturer's name, model, serial number, temperature and pressure design, and any other data necessary to conform with specified requirements. On equipment installed outdoors, nameplate shall be stamped steel or engrave plastic.

2.2 TAGS

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- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. Chart: Typewritten list that is plastic laminated and mounted in mechanical room. Valve list is to coordinate with mechanical piping schematics if provided on plans.
- C. Pipe Schematics: Valve numbers are to be labeled on Engineer schematic drawings, plastic laminated and schematic shall be mounted in mechanical room.

### 2.3 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Provide tape with printing which most accurately indicates the type of service of buried pipe.

## 3. EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic tape pipe and duct markers in accordance with manufacturer's instructions. Directional arrow tape shall be overlapped to ensure proper adhesion and no peeling of tape in future.
- D. Identify air handling units, exhaust fans, chillers, pumps, heat generating, heat rejecting, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- E. Identify pressure reducing valves, backflow preventers, valves, and meters with tags.

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- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify piping, concealed or exposed, with plastic tape pipe markers. For pipes  $\frac{3}{4}$ " and smaller, identify piping with tags. Identify service, flow direction, and pressure when applicable, i.e. low pressure steam, high pressure steam. Install in clear view from floor and align with axis of piping. Locate identification not to exceed 15 feet on straight runs including risers and drops, more often in congested areas, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Provide a minimum one label per pipe per room. Where pipes are racked, install pipe markers on each pipe in the same location to aid in differentiating each pipe in the rack.
- J. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
  - 1. Provide 14 gauge electrical tracer wire above all underground pipe (plastic or other type of utility piping).
- K. Provide ceiling stickers or machine generated labels to locate valves, dampers, or HVAC equipment above T-bar type panel ceilings. Locate ceiling sticker on the ceiling grid closest to equipment. Label each sticker with the device located above the ceiling, i.e. VBR-33.

END OF SECTION 22 05 53

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**SECTION 22 07 19 – PLUMBING PIPING INSULATION**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.2 REFERENCE SECTION 22 05 00 FOR THE FOLLOWING GUIDELINES

- A. Quality assurance.
  - 1. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, and UL 723.
- B. References.
- C. Submittals.
- D. Operation and maintenance manuals.
- E. Project record documents.
- F. Environmental requirements
  - 1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
  - 2. Maintain temperature during and after installation for minimum period of 24 hours.

**2. PRODUCTS**

2.1 GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  - 1. 'K' ('ksi') value: ASTM C335.

Temperature (degrees F)	Maximum 'k' value (btu*in)/(hr*ft <sup>2</sup> *deg F)
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75	0.23
100	0.24
150	0.25
200	0.28
300	0.34
400	0.42
500	0.51

2. Minimum Service Temperature: -20 degrees F.
3. Maximum Service Temperature: 300 degrees F.
4. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket

1. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

C. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive: MIL-A-3316C, Class 2, Grade A compliant. Compatible with insulation. VOC Limit 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Insulating Cement: ASTM C195; hydraulic setting on mineral wool. VOC Limit 70 g/L (multipurpose construction adhesive).

F. Fibrous Glass Fabric: Cloth, untreated; 9 oz/sq yd weight with 1.0 lb/cu ft density blanket.

G. Indoor Vapor Barrier Finish: Vinyl emulsion type acrylic, compatible with insulation, white color. VOC Limit 50 g/L.

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## 2.2 CELLULAR FOAM

- A. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. 'k' ((btu\*in)/(hr\*ft<sup>2</sup>\*deg F)) value: ASTM C177 or C518; 0.21 to 0.27 at 75 degrees F mean temperature rating.
  2. Minimum Service Temperature: -40 degrees F.
  3. Maximum Service Temperature: 220 degrees F.
  4. Maximum Moisture Absorption: ASTM C209; 0.2 percent by volume.
  5. Moisture Vapor Transmission: ASTM E96; 0.08 perm inches.
  6. Maximum Flame Spread: ASTM E84; 25.
  7. Maximum Smoke Developed: ASTM E84; 50.
  8. Connection: Waterproof vapor barrier adhesive.
  9. Provide documentation indicating that product contains no urea formaldehyde.
  10. Fittings: Pre-fabricated closed cell fittings of like material and thickness as adjacent pipe insulation.
  11. In all exposed finished areas without jacketing, provide white insulation, otherwise use black.
- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. MIL-A-24179A, Type II, Class I, compliant. Air dried, contact adhesive, compatible with insulation. VOC Limit: 50 g/L or less when calculated according to 40 CFR 59, Subpart D.

## 2.3 JACKETS

- A. PVC Plastic
1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, white color.
    - a. Minimum Service Temperature: -40 degrees F.
    - b. Maximum Service Temperature: 150 degrees F.
    - c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
    - d. Maximum Flame Spread: ASTM E84; 25.
    - e. Maximum Smoke Developed: ASTM E84; 50.
    - f. Thickness: 20 mil.
    - g. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.
  2. Covering Adhesive Mastic: Compatible with insulation. VOC Limit 50 g/L according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Aluminum Jacket: ASTM B209.
1. Thickness: 0.040 inch.

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2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: PVC pre molded fittings.
5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

C. Stainless Steel Jacket: Type 304 or 316 stainless steel.

1. Thickness: 0.018 inch.
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

**3. EXECUTION**

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Painting of cellular foam insulation is not allowed.**
- C. On exposed piping, locate insulation and cover seams in least visible locations. For cellular foam insulation tape ALL visible seams with tape matching insulation color.
- D. Insulated pipes conveying fluids below ambient temperature:
  1. Provide vapor barrier jackets, factory applied or field applied.
  2. Insulate fittings, joints, flanges, unions strainers, flexible connectors and valves with molded insulation of like material and thickness as adjacent pipe. PVC or aluminum covers are required in all exposed locations as in mechanical rooms.
  3. Finish with glass cloth and vapor barrier adhesive.
  4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Cellular foam insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

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1. Insulate fittings, joints, flanges, unions, strainers, flexible connectors, and valves with molded insulation of like material and thickness as adjacent pipe. PVC or aluminum covers are required in all exposed locations as in mechanical rooms.
  2. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  3. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- F. For insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. PVC covers are required in all exposed locations as in mechanical rooms.
  3. Finish with glass cloth and adhesive.
  4. For hot piping conveying fluids, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Inserts and Shields:
1. Refer to Section 22 05 29 for additional information.
  2. Application: Piping 1 inch diameter or larger.
  3. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  4. Insert Location: Between support shield and piping and under the finish jacket.
  5. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  6. Insert Material: ASTM C640 cork, hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
  7. Provide inserts and/or shields per manufacturer recommendations for cellular foam insulation applications in order to maintain continuous insulation throughout the pipe system. The removal of sections of cellular foam insulation to accommodate pipe supports is not acceptable. Manufacturer products specifically designed for supporting insulation and maintaining the integrity of the insulation system at pipe hanger locations, such as Armaflex Armafix Insulation Pipe Hangers, are acceptable.
- H. Finish insulation at supports, protrusions, and interruptions.
- I. For pipe exposed in finished spaces below 8 feet above finished floor, finish with PVC jacket and PVC fitting covers.
- J. For piping exposed in mechanical rooms below 8 feet above finished floor, finish with aluminum jacket and aluminum fitting covers.
- K. All valves in insulated systems shall have valve stem extensions. Insulation installer shall notify the contractor and Owner if valves without stem extensions are encountered. All valves without stem extensions in areas where stem extensions are required shall be replaced.

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- L. Provide insulation clearance and access to valves and fittings in hangers and from structure and other equipment. Insulation shall be continuous through all hangers and supports. Refer to Section 23 07 19.**

3.3 TOLERANCE

- A. Substituted insulation materials, where allowed, shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 GLASS FIBER INSULATION SCHEDULE

- A. Plumbing Systems

<u>PIPING SYSTEM:</u>	<u>PIPE SIZE:</u>	<u>MIN. THICKNESS:</u>
Domestic Hot Water Supply	1-1/4" & smaller	1"
Domestic Hot Water Supply	1-1/2" & larger	1-1/2"
Domestic Hot Water Recirc	1-1/4" & smaller	1"
Laboratory Hot Water Supply	1-1/4" & smaller	1"
Laboratory Hot Water Supply	1-1/2" & larger	1-1/2"
Laboratory Hot Water Recirc	1-1/4" & smaller	1"

3.5 CELLULAR FOAM INSULATION SCHEDULE

- A. Plumbing Systems

<u>PIPING SYSTEM:</u>	<u>PIPE SIZE:</u>	<u>MIN. THICKNESS:</u>
Domestic Cold Water	6" & smaller	1"
Laboratory Cold Water	6" & smaller	1"
Soft Cold Water	6" & smaller	1"
Tempered Domestic Water	6" & smaller	1"
Tepid Water to Emergency Fixtures	6" & smaller	None
Refrigerant Piping	6" & smaller	1"
Cold Condensate Drain Piping	6" & smaller	1"
Pure (RO) Water (Exposed)	6" & smaller	1"
Pure (RO) Water (Concealed)	6" & smaller	None
Pure (RO) Water (In Mechanical Rooms)	6" & smaller	1"
Plumbing Vents Within 10 Feet of the Exterior Wall Penetration		All sizes 1"
Storm and Overflow Storm	All sizes	1"

END OF SECTION 22 07 19

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**SECTION 22 10 00 - PLUMBING PIPING**

**1. GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary waste and vent piping system.
- D. Bio waste and vent piping system.
- E. Water piping systems.

**1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. Quality assurance.
  - 1. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. References
- C. Submittals
- D. Operation and maintenance manuals.
- E. Project record documents
  - 1. Record actual locations of valves.
- F. Delivery, storage, and handling

**1.3 REGULATORY REQUIREMENTS**

- A. Perform Work in accordance with International Plumbing Code.
- B. Provide lead-free materials (0.25% lead by weighted average) for applicable potable water meters, materials, piping, valves, fittings, backflow preventers, and other items in accordance with NSF/ANSI 61, including Appendix G.

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- C. Provide lead-free materials (0.25% lead by weighted average) for applicable potable water faucets, faucet connectors, hoses, supply stops, and other items in accordance with NSF/ANSI 61, including Appendix 9-G.

#### 1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

#### 1.5 EXTRA MATERIALS

- A. Provide two repacking kits for each size valve.

### 2. PRODUCTS

#### 2.1 SANITARY WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74, hub-and-spigot, service weight.
  - 1. Fittings: Cast iron, ASTM A74, service weight.
  - 2. Joints: ASTM C564 neoprene gasket system equivalent to Tyler Pipe Ty-Seal.

#### 2.2 SANITARY WASTE AND VENT PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888, hubless, service weight.
  - 1. Fittings: Cast iron, ASTM A888, service weight.
  - 2. Joints: Heavy-duty coupling with genuine neoprene gaskets, corrugated stainless steel shield, and stainless steel 4-band (4" and smaller) or 6-band (5" and larger) clamp-and-shield assemblies. Coupling shall meet ASTM C1540, ASTM C564, and FM 1680 Class 1.

#### 2.1 BIO WASTE PIPING, ABOVE GRADE

- 1. Polypropylene Pipe Schedule 40 joined by the coil fusion method. Pipe shall be manufactured of flame retardant homopolymer polypropylene. Flammability requirements are based on ASTM D635 "Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self Supporting Plastics in a Horizontal Position"
- 2. Flame Retardant Polypropylene fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the polypropylene pipe by means of coil fusion method. Fittings shall meet the same flammability requirements as described for pipe above.

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3. All components of the system shall conform to the following applicable ASTM Standards, D4101, D3311, D1599, D2122, F1290 and F1412. All pipe shall be marked with manufacturers name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer's trademark, fitting size, manufacturers part number, and symbol indicating the material.
4. Shall be Fuseal pipe and fittings as manufactured by GF Piping Systems LLC, Irvine CA or approved equal.
  - a. Enfield by IPEX.
  - b. Orion
  - c. Zurn
  - d. Approved equivalent.
5. Products not allowed: Pyrex or other glass pipe.

## 2.2 LABORATORY VENT PIPING, ABOVE GRADE (NON-PLENUM APPLICATIONS)

- A. Flame Retardant Polypropylene (PP) Pipe: ASTM F1412, Schedule 40 extruded pipe and molded drainage-pattern fittings meeting ASTM D1785, manufactured from PP resin complying with ASTM D4101, with socket electrofusion-joint ends. Resin shall include a flame retardant additive meeting ASTM D635.
  1. Fittings: Drainage-pattern molded fittings of same type as pipe material. Fittings shall be designed for socket electrofusion utilizing manufacturer's recommended fusion tools.
  2. Joints: Socket electrofusion joints conforming to ASTM F1290.
  3. Supports: All pipe supports shall use the pipe manufacturer's recommended support system. Support spacing and materials shall be in accordance with the manufacturer's written instructions and recommendations.
  4. Manufacturers: Subject to compliance with all specified requirements, provide products by:
    - a. Enfield by IPEX.
    - b. Orion
    - c. Zurn
    - d. Approved equivalent.
  5. Products not allowed: Pyrex or other glass pipe.

## 2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
  1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
  2. Joints: Lead Free, ASTM B32, Alloy B solder, for piping 1-1/2" and smaller. AWS A5.8, BCuP silver braze, for piping 2" and larger.



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## 2.4 STORM WATER PIPING, BURIED

- A. Cast Iron Pipe: ASTM A74, hub-and-spigot, service weight, bearing CISPI trademark.
  - 1. Fittings: Cast iron, ASTM A74, service weight, bearing CISPI trademark.
  - 2. Joints: ASTM C564 neoprene gasket system equivalent to Tyler Pipe Ty-Seal.
  
- B. PVC Pipe and Fittings: ASTM D2241, PVC 1120, DR 21, PR 200 (SDR-21)
  - 1. Adhesive Primer: ASTM F 656.
  - 2. Solvent Cement: ASTM D 2564.

## 2.5 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888 and/or CISPI 301, hubless, service weight, bearing CISPI trademark.
  - 1. Fittings: Cast iron, ASTM A888 or CISPI 301, service weight, bearing CISPI trademark.
  - 2. Joints: ASTM C-1540, neoprene gaskets and heavy-duty stainless steel 4-band clamp-and-shield assemblies.

## 2.6 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under:
  - 1. Ferrous pipe: 150 psig malleable iron threaded unions.
  - 2. Copper tube and pipe: 150 psig bronze unions with soldered joints.
  
- B. Pipe Size Over 2 Inches:
  - 1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.

2.7 Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

### A. DIELECTRIC NIPPLE

- 1. Standard: IAPMO PS 66.
- 2. Electroplated steel nipple complying with ASTM F1545.
- 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
- 4. End Connections: Male threaded or grooved.
- 5. Lining: Inert and noncorrosive, propylene.

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## 2.8 SWING CHECK VALVES

- A. Up to and including 2 Inches: Bronze swing disc, 125 psig working pressure.
- B. Over 2 Inches: Cast iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

## 2.9 BALL VALVES

- A. Up to and including 4 inches: Bronze two piece body, chrome plated steel full-port ball, teflon seats and stuffing box ring, lever handle.

## 2.10 GATE VALVES

- A. 3 Inches and larger: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge, flanged ends. Class 125, MSS SP-70.
- B. Chainwheel: On valves 6" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

## 2.11 STRAINERS

- A. Size 2 inch and Under: Screwed bronze body for 250 psig working pressure, Y pattern with 20-mesh stainless steel perforated screen.
- B. Size 2-1/2 inch and larger: Flanged cast iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

## 2.12 CALIBRATED BALANCE VALVES

- A. Pre-Set Balance Feature. Valves to be designed to allow Installing Contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with scheduled flow rates.
- B. Valve Design and Construction. All valves shall have a calibrated orifice or venturi section, two 1/4" threaded pressure tap ports with integral seals, and memory stop to retain the set position. Valves should be rated for 125 psig working pressure and 250 Deg. F maximum operating temperature.
- C. Valves shall be selected based on flowrate, not on pipe size dimensions.
- D. Preformed Insulation. All vales to be provided with molded insulation to permit access for balance and read-out.

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2.13 DRAIN VALVES

- A. Equipped with hose adaptor fitting and cap.

**3. EXECUTION**

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Vent pipes shall extend minimum 12" above finish roof line or as required by code.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Provide access where valves and fittings are not exposed.
- J. Establish elevations of buried sanitary and storm piping outside the building to ensure not less than 3 ft of cover.

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- K. Establish elevations of buried water piping outside the building to ensure not less than 5 ft of cover.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Extend chains on valves with chainwheel operators down to maximum 5-feet above finished floor.
- Q. Install strainers in horizontal pipe or in vertical pipe such that flow is downward. Do not install strainers in vertical pipe with flow upward.
- R. Install cast iron piping system according to CISPI Handbook.
- S. Install copper tubing under building slab according to CDA's "Copper Tube Handbook." Install ball valve directly upstream of each floor slab penetration.
- T. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
- U. Install ball valve at all laboratory water connections to fume hoods and other laboratory equipment.

### 3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install valves for shut-off and to isolate equipment, part of systems, and vertical risers.
- C. Install ball valves for throttling, bypass, or manual flow control services.
- D. Provide spring loaded check valves on discharge of water pumps.
- E. Provide plug valves in natural gas systems for shut-off service.
- F. Provide flow control valves in water recirculating systems where indicated. Balance flow to maintain hot water at all plumbing fixtures.

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### 3.5 ERECTION TOLERANCES

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum or as indicated on drawings. Maintain gradients.
- B. Slope water piping and arrange to drain at low points.

### 3.6 PLUMBING PIPING PRESSURE TESTING

- A. Test for leaks and defects all new plumbing piping systems and parts of existing systems, which have been altered, extended or repaired. Submit copy of Pipe Pressure Test Log provided in section 22 05 00 for each section of piping tested. Refer to International Plumbing Code for general pipe pressure testing requirements (i.e., test pressure gauges, inspections, etc.).
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
- C. Repair all leaks and defects using new materials and retest all plumbing systems until satisfactory results are obtained.

### 3.7 DISINFECTION OF WATER PIPING SYSTEMS

- 1. After water systems have been pressure tested and flushed, each system (including distribution system to building) shall be cleaned and disinfected per AWWA C651. Note that procedures shall require two (2) consecutive sets of acceptable samples taken at least 24 hours apart.
- 2. Take samples no sooner than 24 hours after flushing, from outlets and from water entry per AWWA 651, and analyze in accordance with AWWA C651.
- 3. Samples shall be subject to bacteriological testing by a recognized 3<sup>rd</sup> party testing agency. Send test reports to Owner for review. If unsatisfactory bacteriological results are found, the system shall be disinfected and retested again until satisfactory results are obtained.

### 3.8 BIO WASTE WASTE AND VENT INSTALLATION AND TESTING

3.9 Material shall be stored in original packaging and protected from environmental damage until installation. Pipe shall be supported sufficiently to prevent sagging.

3.10 Pipe and fittings shall be installed according to current installation instructions as delivered in print or documented online at [www.gfpiping.com](http://www.gfpiping.com). An on-site installation seminar shall be conducted by GF personnel who are certified to conduct said seminar. Seminar topics shall include all aspects of product installation (storage, set up, support spacing, fusion process, mechanical joint process, testing procedure, etc.). At the conclusion of the installation seminar, all installers will be given a certification test and, upon successful completion of said test, will be

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issued a certification card verifying that they have met the requirements of the manufacturer with regards to knowledge of proper product installation and testing methods.

- 3.11 Only the following GF Piping Systems fusion units may be used to install the Fuseal® PP and Fuseal 25/50™ PVDF Waste Piping system: For Electrofusion Installation: MSA-250SE or Electro Plus® Fusion Machine
- 3.12 Installer shall ensure that all pipe and fittings used for the special waste piping system are components of the same system. No mixing of various manufacturers' pipe and or fittings shall be allowed. Acceptable manufacturers are GF Piping Systems LLC or approved equal
- 3.13 Non-Restrictive Horizontal Pipe Clamps: Plastic pipes shall be supported at distances recommended by the manufacturer according to load, material, temperature, pipe wall thickness and diameter
- 3.14 Plastic pipe supports shall be constructed of an exterior metal supporting bracket of gauge 7 or gauge 11 thickness, depending on size, and an independent plastic insert sleeve sized to allow not more than ¼" annular space between supported pipe and sleeve. Only insert sleeves of the indicated size shall be used for the corresponding supported pipe and sleeve. Only insert sleeves of the indicated size shall be used for the corresponding supported pipe. Supports shall be affixed using appropriate mounting bolts, nuts and washers to 12 gauge rolled structural steel channel, 1 5/8" inch by 1 5/8" minimum, or mounted to structurally sound surfaces suitable to accept mounting hardware.
- 3.15 Non-Restrictive Saddle Hangers Pipe Supports a. Saddle type hangers shall be constructed from 12 gauge rolled structural steel channel, 1 5/8 inch x 1 5/8 inch minimum, strut or stronger as required suitable to support an exterior metal supporting bracket and an independent plastic insert sleeve sized to allow not more than 1/4 inch annular space between supported pipe and sleeve.
- 3.16 Non-Restrictive Clevis Hangers Pipe Supports a. Clevis type hangers shall be constructed of an exterior metal supporting bracket and an independent plastic insert sleeve sized to allow not more than ¼ inch annular space between supported pipe and sleeve. Only insert sleeves of the indicated size shall be affixed to an independent clevis hanger bracket with means to be mounted using all thread rod with appropriate nuts and washers and sized per MSS-SP-5.
- 3.17 Non-Restrictive Vertical Pipe Supports a. Vertical supports shall be mounted similarly to horizontal support with the addition of 35 durometer cushion strips mounted to both sides of plastic insert sleeve.
- 3.18 Thermal Compensating Valve Supports a. Valves shall be supported at distances as recommended by manufacturers and/or according to load, material, temperature, pipe wall thickness and diameter. b. Plastic valve supports shall be a two piece construction, with a primary supporting mounting bracket designed to be structurally attached to a flat surface or a steel strut support of 40mm (1 5/8 inches) width with slots to accept mounting hardware and a second, interlocking valve sliding bracket with suitable slots to affix and mount the valve. When

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assembled, the valve sliding bracket shall be interlocked with the mounting bracket to allow linear movement along a plane that is in-line with the installed pipe. c. Location of the sliding valve support along the mounting bracket shall take into consideration the installation and operating system temperatures to gain maximum valve support throughout an anticipated temperature cycle of the piping system. If equal temperature changes are anticipated (above and below installation temperature) or if conditions are unknown, sliding valve support shall be mounted midway along mounting bracket. d. All valve supports shall be of a two-piece, interlocking construction, manufactured of UV resistant materials and designed to provide full valve support while allowing for linear movement when subjected to thermal expansion or contraction forces acting on the installed piping system. The valve mounting bracket shall provide means of valve attachment without restricting valve movement when affixed to valve mounting support bracket

- 3.19 Testing The system shall be tested in accordance with all local plumbing codes. All sections of the piping system shall be tested with a maximum of 30 foot head of water (approx. 15 psi) for fusion system. Under no circumstances should the system be tested with air or any other gas. Joints may be pressure tested 10 minutes after fusion is completed. (Mechanical joints shall be tested to a minimum 10 foot head or 5 PSI). Fuseal PP and PVDF pipe and fitting systems may be installed for conveyance of pumped discharge up to 50 psi, consult your local GF representative for more information.

END OF SECTION 22 10 00

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**SECTION 22 11 19 - PLUMBING SPECIALTIES**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Cleanouts.
- B. Floor drains and floor sinks.
- C. Installation requirements of other plumbing specialties scheduled in Plumbing Fixture Schedule.

1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

- A. Quality assurance.
- B. References
- C. Submittals
- D. Operation and maintenance manuals.
- E. Project record documents
- F. Delivery, storage, and handling

1.3 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with International Plumbing Code.
- B. Provide lead-free materials (0.25% lead by weighted average) for applicable potable water meters, materials, piping, valves, fittings, backflow preventers, and other items in accordance with NSF/ANSI 61, including Appendix G.
- C. Provide lead-free materials (0.25% lead by weighted average) for applicable potable water faucets, faucet connectors, hoses, supply stops, and other items in accordance with NSF/ANSI 61, including Appendix 9-G.

1.4 CLEANOUTS

- A. Exterior Surfaced Areas: Round or Square cast nickel bronze access frame and non-skid cover.



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- B. Interior Finished Floor Areas: cast iron body and frame, nickel bronze top to accommodate the following floor finishes as required:
  - 1. Exposed rim type with recess to receive tarrazzo or resilient floor finish.
  - 2. Exposed finish type with standard mill finish.
  - 3. Exposed flush type with standard scored or abrasive finish.
  - 4. Concealed undercarpet flush type with mill finish and carpet marker.
- C. Interior Finished Wall Areas: Line type with cast iron body and round gasket cover and round stainless steel access cover secured with machine screw.
- D. Interior Unfinished Accessible Areas: Caulked or threaded type.

1.5 FLOOR DRAINS AND FLOOR SINKS

- A. Refer to Plumbing Fixture Schedule for required product information.
- B. Provide trap primer at new floor sinks and floor drains, see plans.

1.6 OTHER SPECIALTIES

- A. Refer to Plumbing Fixture Schedule for required product information.

**2. EXECUTION**

2.1 PREPARATION

- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

2.2 INSTALLATION

- A. All Plumbing Specialties:
  - 1. Install in accordance with manufacturer's instructions.
- B. Cleanouts:
  - 1. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
  - 2. Encase exterior cleanouts in concrete flush with grade.

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C. Floor Drains / Floor Sinks:

1. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
2. Position floor drains for easy access and maintenance.
3. Unless dimensioned on drawings, location of drains shown on plans are approximate. Installing contractor shall be responsible for coordinating final location with other trades to ensure proper coordination with other building elements including but not limited to: structural members (above/below grade), owner-furnished equipment, walls, and bathroom partitions. Upon identifying a coordination conflict, the contractor shall notify the Engineer of Record by way of RFI with suggested location for drain and obtain approval of new location. No additional compensation shall be provided by Owner for lack of coordination.
4. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
  - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
  - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
  - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
5. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
6. Install barrier-type trap seal protection device in all floor drains and sinks, unless noted otherwise on plans.

END OF SECTION 22 11 19

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**SECTION 22 40 00 - PLUMBING FIXTURES**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Installation requirements of plumbing fixtures scheduled in Plumbing Fixture Schedule.
- B. Plumbing fixture carriers.

1.2 REFERENCE SECTION 22 05 00 FOR THE FOLLOWING GUIDELINES

- A. References
- B. Submittals
- C. Quality Assurance
- D. Delivery, Storage and Handling

1.3 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.
- B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

**2. PRODUCTS**

2.1 PLUMBING FIXTURES

- A. Refer to Plumbing Fixture Schedule for all required product information.
- B. The Contractor is responsible for ensuring that all roof drains are compatible with roof types and roof insulation. Refer to architectural and structural plans for roof information. No additional compensation will be allowed for failure to coordinate roof drains with roof types.

2.2 PLUMBING FIXTURE CARRIERS

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- A. All wall mounted fixtures such as wall-mounted handwashing sinks, etc. shall be installed with compatible carriers. All carriers shall be commercial or industrial grade and shall be suitable for the fixture served, space available and building construction. All carriers shall extend to the floor and be anchored into the slab.

### **3. EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Verify that electric power is available and of the correct characteristics.

#### **3.2 PREPARATION**

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install each fixture with trap with 2 slip joints, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with scheduled wall supports or wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

#### **3.4 LAVATORY AND SINK INSTALLATION**

- A. Install lavatories and sinks level and plumb according to roughing-in drawings.

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- a. Install supports, affixed to building substrate, for wall-mounted lavatories and sinks.
- b. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1. Coordinate exact locations with drawings.
- c. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- d. Seal joints between lavatories/sinks, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- e. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.
- f. Install water-supply piping with stop on each supply to each faucet.
  - 1) Exception: Use ball, gate, or globe valves if supply stops are not specified with lavatory/sink.
  - 2) Install stops in locations where they can be easily reached for operation.

### 3.5 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

### 3.6 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.7 CLEANING

- A. Directly prior to project turnover, clean plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets, urinals, and fittings.
- C. Do not allow use of plumbing fixtures for use during construction unless approved in writing by Owner.

END OF SECTION 22 40 00

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## **SECTION 22 61 13 – COMPRESSED AIR, VACUUM, AND SPECIALTY GAS SYSTEMS**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

A. Equipment, accessories, pipe, and pipe fittings for:

1. Compressed air system.

#### **1.2 REFERENCE SECTION 22 05 00 FOR THE FOLLOWING:**

A. Quality assurance.

1. Perform work in accordance with NFPA 99.
2. Brazing Qualifications: Must meet the brazing qualification standard outlined in NFPA 99.

B. References.

C. Submittals.

D. Operation and maintenance manuals.

E. Project record documents.

F. Delivery, storage, and handling.

G. Warranty

1. Products included in this specification section shall have a 1-year warranty.

#### **1.3 REGULATORY REQUIREMENTS**

A. Conform to NFPA 99 for Level 1 gas systems and applicable codes for laboratory gas systems.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of systems.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or other testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.



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## 2. PRODUCTS

### 2.1 PIPE AND FITTINGS

#### A. Compressed Air, Laboratory Vacuum, and Specialty Gas:

1. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue for Type L tube.
2. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
3. Joints: Brazed, AWS A5.8 Classification BCuP Series, copper-phosphorous alloys.
4. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
5. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
  - a. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
  - b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

### 2.2 VALVES

#### A. Factory Preparation for Laboratory Gas Service: Disassemble, clean, degrease, seal, and pack for shipping.

#### B. Ball Valves:

1. Shut off valve shall be full-port, double seal, ball-type three-piece design with bronze/brass body and chrome plated brass ball. Only 1/4 turn of the handle shall be required to operate the valve from open to closed position. All valves shall be serviceable in the line and supplied clean and prepared for oxygen service. Color-coded gas identification labels shall be provided with each valve. Valves shall be oxygen cleaned, capped, and poly-bagged per CGA G-4.1. Each polyethylene bag is labeled with CGA G-4.1 conformance. Valve handle shall include a locking mechanism.
2. Valves shall be designed for a maximum working pressure of 600 psig WOG or vacuum service to 29" Hg. Valve body shall have reinforced PTFE ball seat and reinforced PTFE stem seals, and include a blowout proof stem. Seats/seals, lubricants and valve material shall be compatible with compressed air, vacuum, helium, argon, nitrogen and mixtures thereof at continuous pressure up to 600 psig and up to 100° F. Valves shall be provided with type K copper tube extensions for making connections to the pipeline. Valves conform to MSS SP-110. Type K copper tube extensions shall conform to ASTM B88, UNS No. C12200, and H58 temper.

#### C. Check Valves:

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1. Check valves shall be inline pattern, bronze construction, rated for 300 psig, spring-loaded, with manufacturer-installed ASTM B819 copper-tube extensions.

## 2.3 INLET/OUTLET PORTS

- A. See schedules on drawings.

## 2.4 PIPING ACCESSORIES

- A. Hangers and Supports: MSS SP-58 with types as required by MSS SP-69.
- B. Pressure Gauges:
  1. ANSI B40.1, white dials and black lettering with restrictor.
  2. Manufactured and labeled expressly for intended service; UL labeled.
- C. Flexible Connectors: Corrugated flexible, single ply, seamless or seam-welded tubing of stainless steel or bronze or reinforced teflon bellows or hose.

## 3. EXECUTION

### 3.1 INSTALLATION

- A. Make air cock and drain connection on horizontal casing.
- B. Connect condensate drains to nearest floor drain.
- C. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
- D. Install valved drip connections at low points of piping system.
- E. Install take offs to outlets from top of main, with shut off valve after take off. Slope take off piping to outlets.
- F. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.
- G. Install tees instead of elbows at changes in direction of vacuum piping. Fit open end of each tee with plug.
- H. Identify piping system and components. Refer to Section 22 05 53.

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- I. Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal of water. After washing, rinse with water, dry and cap until installation.
  - J. Braze joints in pipe and tubing. Avoid leaving excess flux inside of pipe and fittings. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
  - K. Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Make bends free of flattening, buckling or thinning of tube wall.
  - L. Cut pipe and tubing accurately and install without springing or forcing.
  - M. Grade piping down in direction of flow.
  - N. Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 2 inches above finished floors. Pack space between pipe or tubing and sleeve, and calk.
  - O. Support gas piping with pipe hooks or hangers suitable for size of pipe, spaced:
    - 1. 1/2 inch pipe or tubing or less: 72 inches.
    - 2. 3/4 inch or one inch pipe or tubing: 96 inches.
    - 3. 1-1/4 inches or larger (horizontal): 120 inches.
    - 4. Vertical pipe or tubing: Every floor level.
  - P. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.
  - Q. Install copper tubing under building slab according to CDA's "Copper Tube Handbook." Install ball valve directly upstream of each the floor slab penetration.
  - R. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
  - S. Install ball valve at all connections to equipment.
- 3.2 FIELD QUALITY CONTROL
- A. Compressed Air Piping and Vacuum Piping Leak Test: Cap and fill piping system with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate the test source and let stand for four hours to equalize temperature. Refill system, if necessary, to test pressure; hold for two hours with no drop in system pressure.

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- B. Repair or replace compressed air piping or vacuum piping as required to eliminate leaks, and retest to demonstrate compliance.
  
- C. Verify that the manufacturer has started up all medical air vacuums, and that they are in operating order.

END OF SECTION 22 61 13

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## **SECTION 23 05 00 - BASIC HVAC REQUIREMENTS**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. This section describes Basic Mechanical Requirements to provide for a complete installation of all mechanical systems for this project. This section shall apply to all other Division 23 specification sections as well as all work shown on the drawings.
- B. Mechanical demolition requirements.
- C. It is the intent of the Mechanical Division of the Specifications that all mechanical work specified herein be coordinated as required with the work of all other Divisions of the Specifications and Drawings so that all installations operate as designed.
- D. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation to the satisfaction of the Owner's representative.
- E. The Contractor shall note that, in some cases, piping as shown on the Drawings provide general location and routing information only. The Contractor shall be responsible for providing interference-free systems with proper clearance to facilities and equipment.
- F. Where the word "provide" is used, it shall mean "furnish and install" unless otherwise noted or specified.
- G. Note that the words "mechanical" and "plumbing" are used interchangeably throughout the Division 22 and 23 specification sections.

#### **1.2 RELATED SECTIONS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section and all other sections of Division 23.

#### **1.3 DESCRIPTION OF WORK**

- A. The work included under this section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete mechanical systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work,

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indicating the intended general arrangement of equipment, piping fixtures, etc. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.

#### 1.4 QUESTIONS OF INTERPRETATION

- A. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation not issued in the form of an addendum shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.
- B. The Architect/Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

#### 1.5 CONTRACT DOCUMENT DISCREPANCIES

- A. If any ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of bid.
- B. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of three-dimensional objects. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies should be 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.
- C. The Contractor shall follow the drawings in laying out work and verify clearances for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of materials or equipment, obtain instructions from the Architect/Engineer before proceeding with the work.
- D. If there is a conflict between manufacturer's recommendations and the Contract Documents, the manufacturer's recommendations shall govern with no additional cost to the Owner.

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1.6 PERMITS

- A. All permits, fees, licenses, etc. required for this project shall be obtained by the Contractor.

1.7 QUALITY ASSURANCE

- A. Installers shall have at least 2 years of successful installation experience on projects with mechanical installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation, unless noted otherwise in other mechanical sections.
- B. Manufacturer of equipment and materials must be regularly engaged in the manufacture of the specified equipment and material with similar construction and capacities and whose products have been in satisfactory use in similar service for not less than five (5) years, unless noted otherwise in other Mechanical Sections.
- C. Qualify welding processes and operators for structural steel according to AWS D1.1. "Structural Welding Code - Steel.
- D. Quality welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- E. Comply with provisions of ASME B31 Series "Code for Pressure Piping", including all addenda.
- F. Contractor signed welder certificate(s) shall be submitted. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current. A record shall be maintained on the job site showing the date and results of qualification tests for each welder employed on the job. One certified copy of the qualification test for each welder so employed shall be furnished to the Owner's representative.
- G. For all the refrigerant work/service required by this project, all refrigerant technicians shall be EPA/ASHRAE 34 certified for corresponding classification type I, II, III and/or IV.

1.8 REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall conform to the following as applicable:
  - 1. Safety and Health Regulations for Construction.
  - 2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
  - 3. ABMA - American Boiler Manufacturers Association.
  - 4. ACCA - Air Conditioning Contractors of America.



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5. ACGIH - American Conference of Governmental Industrial Hygienists.
6. ADC - Air Diffusion Council.
7. AGA - American Gas Association.
8. AIHA - American Industrial Hygiene Association.
9. AMCA - Air Movement and Control Association.
10. ANSI - American National Standards Institute.
11. ARI - Air-Conditioning and Refrigeration Institute.
12. ASA - Acoustical Society of American.
13. ASHRAE - American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
14. ASME - The American Society of Mechanical Engineers.
15. ASTM - American Society of Testing and Materials.
16. CAGI - Compressed Air and Gas Institute.
17. CTI - Cooling Tower Institute.
18. EJMA - Expansion Joint Manufacturers Association.
19. ETL - Engineering Tests Laboratory.
20. HEI - Heat Exchange Institute.
21. HI - Hydraulic Institute.
22. HYD I - Hydronics Institute.
23. ICBO - International Conference of Building Officials.
24. ICC – International Code Council.
25. NEBB - National Environmental Balancing Bureau.
26. NEC - National Electrical Code.
27. NEMA - National Electrical Manufacturers Association.
28. NFPA - National Fire Protection Association.
29. NSF - National Sanitation Foundation.
30. SAE - Society of Automatic Engineers.
31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
32. TEMA - Tubular Exchanger Manufacturers Association.
33. UL - Underwriters Laboratories, Inc.
34. International Plumbing Code.
35. International Mechanical Code.
36. NIH DRM – National Institute of Health Design Requirements Manual
37. Other governing, state, and local codes that apply.

1.9 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Sections "General Conditions" and "Special Conditions".
- B. Shop drawings shall include the minimum following information as applies. Additional specific information required is outlined in other Mechanical Sections.
  1. Certified performance and data with system operating conditions indicated (winter and summer performance as necessary). All coil, fan, and pump performance data shall be computer generated.

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- a. Submit sound power level data for all inlets, outlets, and casing radiation at rated capacities for all air handling equipment. Provide calculated sound power data based on AMCA 320 sound intensity test methods.
  - b. Where filters are included with equipment, provide data of filter media, filter performance data, filter assembly, and filter frames.
2. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicating, weights (shipping, installed, and operating), furnished specialties and accessories; and installation and start-up instructions.
  3. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances, gages and finishes of materials, and methods of assembly of components.
  4. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to electrical equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of electrical equipment and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  5. Maintenance Data: Submit maintenance data and parts list for each mechanical equipment, control and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.
- C. Provide separate shop drawing submittals for all items listed in Shop Drawing and Submittal Log in Division 1.

1.10 SUBSTITUTES

- A. Refer to the General Conditions and Special Conditions sections of this Specification for general substitution requirements and information.
- B. All proposals shall be based on providing and installing the materials or items of equipment which are hereinafter specified.
- C. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing. Associated mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are to be increased accordingly, but all recommended manufacturer clearances, etc., are to be maintained within the allotted mechanical spaces. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- D. Where the terms "or equivalent" is used, the Contractor may substitute alternate equipment, materials, etc. subject to review by the Architect/Engineer and the Owner's representative during the submittal phase of the project.

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- E. Where the term "or approved equivalent" is used, the Contractor may not substitute alternate equipment, materials, etc. unless requesting approval at least ten (10) days before the bid date. Notifications of any such approvals by the Architect/Engineer shall only be made in writing by Addendum.
- F. Where the term "no equivalent" is used, the Contractor must provide the specified or scheduled equipment, materials, etc.
- G. Final determination regarding substitutions shall be by the Architect/Engineer.

1.11 WARRANTY

- A. Refer to the General Conditions section of this Specification for general warranty requirements and information. Additional warranty requirements are specified in subsequent Mechanical Sections.

1.12 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Operate each system and item of equipment in a test run of appropriate duration, but no less than 7 days, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Any system placed in temporary operation for testing or for the convenience of the Contractor during construction shall be properly maintained and operated by the Contractor.
- C. All systems shall be protected against freezing, flooding, corrosion or other forms of damage prior to acceptance by the Owner.
- D. Material or equipment damaged, shown to be defective or not in accordance with the Specifications shall be repaired or replaced to the satisfaction of the Owner's representative.
- E. All tests shall be made after notification to and in the presence of the Owner's representative.
- F. Before starting up any system, each piece of equipment comprising any part of the system shall be checked for proper lubrication and any other condition which may cause damage to the equipment or endanger personnel.
- G. After systems have been demonstrated to be satisfactory for 7 consecutive days and ready for permanent operation, all permanent pipe line strainers shall be cleaned, valve and packings properly adjusted, lubrication checked and replenished if required. Temporary piping, etc. shall be removed and openings restored in a permanent manner acceptable to the Owner's representative.

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- H. Conduct a walk-through instruction seminar for the Owner's personnel pertaining to the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, maintenance requirements, operational diagrams, temperature control provisions, sequencing requirements, security, safety, efficiency and similar features of the systems. Walk through must be documented as to those attending and subjects covered. Walk through document(s) shall be signed and dated by the contractor's representative and the owner's representative.
  - 1. Provide instructional training as outlined in individual equipment specification sections.
- I. At the time of substantial project completion, turn over the prime responsibility for operation of the mechanical equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.
  - 1. If any systems are operated prior to substantial completion, the contractor shall perform all necessary preventative maintenance according to all manufacturer recommendations.

1.13 RECORD DOCUMENTS

- A. Prepare as-built documents in accordance with the requirements in Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in above, indicate the following installed conditions:
  - 1. The Mechanical Contractor shall provide the Owner with as-built drawings for ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units and indicate all devices requiring periodic maintenance or repair, such as control power transformers, LACS panels/routers, field controllers, duct static pressure sensors, piping pressure sensors, etc.
  - 2. All mechanical systems as described in the Specifications and/or shown on the drawings.
  - 3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Mechanical Identification." Indicate actual inverts and horizontal locations of underground piping.
  - 4. Equipment/material locations (exposed and concealed), dimensioned from prominent building lines.
  - 5. All items must be dimensioned in horizontal and vertical plans to allow Architect/Engineer to update Building Information Model (BIM) file for Owner.

1.14 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 1, include the following information for

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equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

- B. Provide electronic copies, preferably in Adobe Acrobat Portable Document Format (pdf), of all maintenance manuals to Temperature Control Contractor for use in EMCS front-end system. Provide data in file types compatible with EMCS.

**2. PRODUCTS (NOT APPLICABLE).**

**3. EXECUTION**

**3.1 MECHANICAL DEMOLITION**

- A. Refer to Division 02 Sections for selective demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components specified under Division 23 and as indicated on the drawings.
1. Controls
  2. Demolition related to others areas that must remain on line.
  3. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  4. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  5. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  6. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  7. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  8. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  9. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

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- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality. Refer to specific system specification for product information.

### 3.2 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Store and handle material and equipment in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Use proper lifting equipment where size/weight requires handling by such means.
- D. Comply with manufacturer's rigging and moving instructions for unloading material and equipment, and moving them to final location.
- E. Equipment requiring disassembly for access purposes shall be disassembled and reassembled as required for movement into the final location following manufacturer's written instructions.
- F. Deliver material and equipment as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- G. Mechanical Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

### 3.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

### 3.4 COORDINATION

- A. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- B. Coordinate the mechanical work with work of the different trades so that:
  - 1. Interferences between mechanical, electrical, architectural, and structural work, including

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- existing services, will be avoided.
2. Within the limits indicated on the drawings, the maximum practicable space for operation, maintenance repair, removal and testing of mechanical and other equipment will be provided.
  3. Pipes, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.
- D. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.

### 3.5 MECHANICAL INSTALLATIONS

- A. All dimensions and clearances affecting the installation of work shall be verified in the field in relation to established datum, to building openings and to the work of other trades.
- B. The location of all equipment and systems shall be coordinated to preclude interferences with other construction.
- C. Should interferences occur which will necessitate deviations from layout or dimensions shown on the Drawings, the Architect/Engineer and the Owner's representative shall be notified and any changes approved before proceeding with the work.
- D. Arrange for chases, slots, and openings in other building components during progress of construction to allow for mechanical installations.
- E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- G. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
- H. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

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- I. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- J. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- K. Welding, sweating, or brazing operations
  - 1. All cutting, welding, brazing, or sweating operations carried on in the vicinity of, or accessible to, combustible material shall be adequately protected to make certain that a spark or hot slag does not reach the combustible material and start a fire.
  - 2. When it is necessary to do cutting, welding, brazing, or sweating close to wood construction, in pipe shafts, or other locations where combustible materials can not be removed or adequately protected, employ fireproof blankets and proper fire extinguishers. Position another individual nearby to guard against sparks and fire.
  - 3. Whenever combustible material has been exposed to molten metal or hot slag from welding or cutting operations, or spatter from electric arc operations, a guard shall be kept at the place of work for at least one hour after completion to verify that smoldering fires have not been started.
  - 4. Whenever welding or cutting operations are carried on in a vertical shaft or where floor openings exist, a fire guard shall be employed to examine all floors below the point of the welding or cutting operation. The fire guard shall be kept on duty for at least one hour after completion to verify that smoldering fires have not been started.
  - 5. Before any work involving cutting, welding, brazing, or sweating operations is started, consult with the Architect/Engineer as to particular safety precautions to be employed on the work.

### 3.6 ACCESSIBILITY

- A. All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring periodic lubrication, cleaning, adjusting or servicing of any kind.

### 3.7 LUBRICATION AND TOOLS

- A. Provide a fresh charge of lubricant in accordance with manufacturer's recommendations to all equipment requiring lubrication prior to start-up and maintain lubrication as required until acceptance by Owner.
- B. Provide for each piece of equipment any special tools and a list of such tools required for the operation or adjustment of the equipment and turn over to the Owner's representative prior to final acceptance of the equipment.



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### 3.8 START-UP

### 3.9 PIPING SYSTEMS PRESSURE TESTING

- A. The following personnel in the order listed shall be considered acceptable witnesses of all piping pressure testing:
  - 1. Local Authority Having Jurisdiction
  - 2. Owner's Representative
  - 3. Mechanical Engineer / Architect
  - 4. General Contractor's Foreman
- B. Removal of pressure charge and associated drain down shall also be witnessed.
- C. Mechanical contractor shall provide a minimum of 24-hour notice to at least one of the above listed parties before commencing any piping systems pressure test.
- D. Pressure gauge requirements: Provide recently calibrated gauge with 4" face and a range such that test pressure is between 50% and 100% of gauge range. For example, a gauge with a 15 psig range is acceptable for a 10 psig pressure test, whereas a gauge with a 30 psig range is unacceptable in this application. Gauge resolution shall be suitable for type of testing, system size and test media. Gauge shall have been recently calibrated.
- E. All piping pressurizing equipment (i.e., air compressor) shall be disconnected before test is commenced and shall remain disconnected for the entire duration of the test.
- F. Entire system shall be properly vented before test is commenced.
- G. For specific piping pressure testing requirements and procedures, see applicable piping systems specification sections.
- H. Submit completed "Pipe Pressure Test Log" provided at the end of this Section for each pressure test before final project closeout. Test log shall also be included in operation and maintenance manuals.

**NOTE: USE MULTIPLE FORMS IF NECESSARY**

### 3.10 GENERAL CONTRACTOR - MECHANICAL EXTENT OF WORK

- A. Access Panels
  - 1. Furnish and install panels for access to valves and dampers and similar items where no other means of access, such as readily removable, sectional ceiling is shown or

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- specified.
2. The plans indicate the location of all anticipated access panels. The Division 23 Contractor shall make every effort to locate all material and equipment requiring service and maintenance above accessible ceilings or utilize the indicated access panels. Material and equipment requiring service and maintenance that is shown above inaccessible ceilings shall be relocated to accessible or exposed areas whenever possible. When these items are located in exposed areas, the Division 23 Contractor is to verify with the Architect/Engineer that the installation will not affect the aesthetics of the building. However, when it is not possible to locate these items in accessible or exposed areas due to the configuration of the actual installation of the mechanical and other trade systems or aesthetic reasons, additional access panels shall be provided. The contractor shall be equitably compensated for the additional access panels.
  3. Refer to Section 08 31 13 – Access Doors and Panels for specific information on type and size of panels

B. Cutting and Patching

1. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
2. The Division 23 Contractor shall coordinate all cutting and patching of holes, in existing building and new construction which are required for the passage of mechanical work.
3. Division 23 Contractor is to notify the General Contractor prior to submitting his bid, the number, size and location of all cutting and patching requirements. The Division 23 Contractor shall be liable for all associated costs of cutting and patching for mechanical work upon failure to notify the General Contractor prior to bid submission.
4. Under no circumstances shall any structural members, load-bearing walls or footings be cut without first obtaining written permission from the Engineer.
5. Cut, channel, chase and core drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
6. Patching of concrete openings shall be filled with grout and finished smooth with the adjacent surface.
7. All below-grade openings for pipe shall be sealed with interlocking synthetic rubber line assembly, Link-Seal by Thunderline Corporation or equal.
8. **All penetrations through the walls, floor, or structure of laboratory spaces, laboratory support spaces, lecture halls, classrooms, conference rooms, corridors or other areas in which relative pressurization relationships are important shall be sealed airtight. Refer to the drawings for additional information regarding rooms in which maintaining pressurization is important.**
9. Repair cut surfaces to match adjacent surfaces.
10. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
  - a. Uncover work to provide for installation of ill-timed work.
  - b. Remove and replace defective work.

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- c. Remove and replace work not conforming to requirements of the Contract Documents.
- d. Remove samples of installed Work as specified for testing.
- e. Install equipment and materials in existing structures.
- f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

C. Concrete Bases

1. Provide 4" high concrete housekeeping pads (unless otherwise noted) shall be provided under floor mounted mechanical equipment. Thicker pads are not allowed unless approved by engineer. Concrete inertia pads shall be provided for all base-mounted pumps and air compressors installed in the penthouse area.
2. Division 23 Contractor is to notify the General Contractor prior to submitting his bid, the number, size and location of all mechanical equipment bases. The Division 23 Contractor shall be liable for all associated costs to install the mechanical equipment bases upon failure to notify the General Contractor prior to bid submission.
3. Construct concrete equipment bases a minimum 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 psi, 28-day compressive strength concrete, reinforcement and forms as specified in Division 3 Section "Cast-In-Place Concrete." Coordinate final equipment base size with General Contractor.

D. Roof curbs, roof support for mechanical equipment and roof penetrations.

1. Division 23 Contractor is to coordinate with the General Contractor all roof curb and roof supports supplied, number, size and location of all roof penetrations. All major roof penetrations are shown on the architectural roof plan. General Contractor shall be notified of all additional roof penetrations provided by the Division 23 Contractor not shown on this plan. The General Contractor shall provide all roof deck mounted equipment and pipe supports, pipe penetrations and cut roof deck for pipe and duct penetrations, unless noted otherwise. The Division 23 Contractor shall furnish all roof curbs and the General Contractor shall install, unless noted otherwise. The Division 23 Contractor shall provide all roof covering/membrane mounted equipment and pipe supports and roof drains, unless noted otherwise.
2. The Division 23 Contractor shall be liable for all associated costs to install the roof curbs, roof supports and roof penetrations not shown on the roof plan or added after the roof system has been installed. Coordinate with the General Contractor prior to construction the number size and location of all roof penetrations.
3. Division 23 Contractor is to coordinate with the General Contractor all roof curb and roof supports supplied, number, size and location of all roof penetrations. All major roof penetrations are shown on the architectural roof plan. General Contractor shall be notified of all additional roof penetrations provided by the Division 23 Contractor not shown on this plan.

E. Painting

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1. The General Contractor is to field paint mechanical equipment and materials in specified areas as noted on the mechanical plans, mechanical schedules and in the specifications. Division 23 Contractor is to coordinate the painting of these items with the General Contractor. The Mechanical Contractor is to provide materials in these areas that are suitable for accepting paint. The clean and preparation of the materials to reach paint is the responsibility of the General Contractor unless noted specifically to be responsibility of the Division 23 Contractor.
2. In concealed locations, field-fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed and shall be painted with one coat of zinc rich paint.
3. In exposed locations, field-fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed and shall be painted in accordance with Section 09 91 00.

3.11 ELECTRICAL-MECHANICAL EXTENT OF WORK

- A. The responsibility of work specified under Division 23 and 26 is clarified under, Section 23 05 13, "Electrical Requirements for Mechanical Equipment. Division 23 Contractor is to coordinate all electrical requirements prior to ordering powered mechanical equipment.

END OF SECTION 23 05 00

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**SECTION 23 05 29 – HVAC HANGERS AND SUPPORTS**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Pipe, ductwork, and equipment hangers, supports, anchors, saddles and shields.
- B. Mechanical flashing.
- C. Equipment curbs.
- D. Mechanical sleeves and seals.
- E. Flashing and sealing equipment and pipe stacks.
- F. Sealants, firestop insulation, putty and compounds.

1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

- A. Quality assurance.
- B. References.
- C. Submittals.
- D. Operation and maintenance manuals.
- E. Project record documents.
- F. Delivery, storage, and handling.

**2. PRODUCTS**

2.1 PIPE HANGERS AND SUPPORTS

- A. Hydronic Piping:
  - 1. Conform to International Mechanical Code, ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89 as applicable.

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B. Steam and Steam Condensate Piping:

1. Conform to International Mechanical Code, ASME B31.1, ASTM F708, MSS SP58, MSS SP69, MSS SP89, as applicable.

C. Refrigerant Piping

1. Conform to International Mechanical Code, ASME B31.1, ASTM F708, MSS SP58, MSS SP69, MSS SP89, as applicable.

D. Hangers and Supports:

1. Hangers for Hot and Cold Pipe Sizes 1/2 to 1-1/2 Inch, Carbon steel, adjustable swivel, band type.
2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 to 4 Inches; Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
14. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
15. Roof Support for Hot and Cold Pipe: See PIPE STANDS section below.
16. **Hangers for insulated pipe shall be enlarged to compensate for insulation thickness so that hangers support insulation. See Section 23 07 19.**
17. See Section 23 05 48 for vibration isolation hangers and supports if applicable.

## 2.2 DUCTWORK HANGERS AND SUPPORTS

- A. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

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- B. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- C. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Exposed Stainless-Steel Ducts: Stainless-steel shapes and plates.

## 2.3 ACCESSORIES

- A. Hanger Rods: ASTM A36 steel or galvanized threaded both ends, threaded one end, or continuous threaded.
  - 1. Ductwork: Use double nuts and lock washers on threaded rod supports.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Internally Threaded Screw Anchors: Internally threaded, self tapping screw anchors, Power Fasteners Snake or approved equivalent.
  - 1. Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI318 (Strength Design method using Appendix D)

## 2.5 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

## 2.6 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.



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- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
  - 1. Waterproofing: 5 lb/sq ft sheet lead
  - 2. Soundproofing: 1 lb/sq ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet buty; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.7 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.

2.8 SEALANTS, FIRESTOP INSULATION, PUTTY, AND COMPOUNDS

- A. Firestopping Insulation: Glass fiber type, non-combustible, UL listed.
- B. Firestop Putty: Non-hardening, non shrinking, UL listed.
- C. Firestop Compounds: Cementitious material, non-shrinking, UL listed.
- D. Sealants:
  - 1. Non fire/smoke rated partitions: Acrylic or silicone based caulking.
  - 2. Fire/smoke rated partitions: Silicone based caulking, UL listed.

2.9 MECHANICAL SEALS

- A. Mechanical Seals: Modular mechanical type, consisting of interlocking EPDM synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with type 316 stainless steel bolts and reinforced plastic polymer pressure plates which cause rubber sealing elements to expand when tightened, providing a watertight and gas-tight seal and electrical insulation. Provide Advance Products & Systems Model Innerlynx or equivalent.

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1. Provide high-temperature silicone links rated for 400 Deg. F for steam and condensate applications.
2. A sleeve shall be provided for each mechanical seal.
  - a. Thermoplastic sleeves: Sleeve shall have smooth walls and shall be made of molded non-metallic high density polyethylene (HDPE) with an integral solid water stop, Advance Products & Systems Model PWS or equivalent.
  - b. Steel sleeves: Sleeve shall have smooth walls, shall be made of Schedule 40 steel with an integral welded solid water stop, and shall have corrosion-resistant coating, Advance Products & Systems Model GWS or equivalent.

### 3. EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

#### 3.2 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

#### 3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Support fire protection systems piping independently from other piping systems. Fire main piping may be trapezed with other piping systems. Coordinate trapeze hangers with the Sprinkler Contractor.
  1. Reference sections 21 05 29 and 22 05 29 for additional information regarding fire protection and plumbing piping supports and hangers.

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- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for non-insulated copper pipe.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat steel hangers and supports in the mechanical room and other exposed areas. Refer to the Architectural reflected ceiling plans for location of exposed ceilings. Hangers and supports located in attic space, crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Adjust hangers to distribute loads equally on attachments and to achieve specified pipe slopes.
- N. Saddles, Shields and Inserts
  - 1. Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
  - 2. Install protective shields MSS Type 40 on cold piping that has vapor barrier. Shields shall span an arc of 180 degrees (360 degrees on trapeze hangers with U-bolt clamps) and shall have dimensions in inches not less than the following:

<u>NPS</u>	<u>LENGTH</u>	<u>THICKNESS</u>
1 through 3-1/2	12	0.048
4	12	0.060
5 & 6	18	0.060
8 through 14	24	0.075

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16 through 24                      24                                      0.105

3. Pipes 8 inches and larger shall have wood inserts.
4. Insert materials shall be at least as long as the protective shield.
5. Provide manufacturer-recommended saddles, inserts, and/or shields where cellular foam insulation is used. The removal of sections of cellular foam insulation for the purpose of pipe support is not acceptable.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

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- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### 3.6 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls and floors.
- B. Flash drains in floors with topping over finished area with lead, inches clear on sides with minimum 36 x 36 inch sheet size. Fasten to drain clamp device.
- C. Seal floor, shower, mop sink, etc. drains watertight to adjacent materials.
- D. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.7 SLEEVES

- A. Provide pipe and duct sleeves at all fire/smoke rated partitions, exterior wall penetrations and wall penetrations into exposed areas. Pipe and duct sleeves are not required for penetrations through non-rated concealed partitions.
- B. At the Contractor's option, pipe sleeves may be omitted if the wall or floor is core drilled.
- C. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Sleeves through floors shall be grinded flush with finish floor level.
- F. Where piping or ductwork penetrate non-rated ceilings or walls, close off space between pipe or duct and adjacent work with urethane rod stock and caulk air tight.

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G. Seal pipe and duct penetrations through non-rated floors.

1. Where piping is not located in a rated shaft and it penetrates a single non-rated floor, close off space between pipe and adjacent work with urethane rod stock and caulk air tight.
2. Where piping is not located in a rated shaft and it penetrates multiple non-rated floors, close off space between pipe and adjacent work with appropriate fire-rated sealant, insulation, putty, or compound.
3. Where ductwork is not located in a rated shaft and it penetrates a single non-rated floor, close off space between duct and adjacent work with appropriate fire-rated sealant, insulation, putty, or compound.
4. Where ductwork is not located in a rated shaft and it penetrates multiple non-rated floors, close off space between duct and adjacent work with appropriate fire-rated sealant, insulation, putty, or compound. Install fire damper in duct at each floor level. Ductwork containing fume exhaust air shall not be provided with fire dampers.

H. Where piping or ductwork penetrate rated floor, ceiling, or wall, close off space between pipe or duct with appropriate fire rated sealant, insulation, putty or compound. Refer to the Drawings for fire/smoke rated wall locations and the appropriate ratings.

I. Provide on ductwork close fitting metal collar or escutcheon covers on the side of penetration that are exposed to view.

J. Install chrome plated steel escutcheons on piping at finished surfaces.

K. Provide mechanical seals and sleeves through exterior wall and floor penetrations and 3 hour or higher fire rated partitions.

3.8 HANGER SCHEDULES

A. Reference International Plumbing Code and International Mechanical Code where applicable.

END OF SECTION 23 05 29

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## **SECTION 23 05 53 - HVAC IDENTIFICATION**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe Markers.
- D. Ceiling Tacks/Stickers.
- E. Duct Markers.

#### **1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. Quality assurance.
- B. References.
- C. Submittals.
- D. Operation and maintenance manuals.
- E. Project record documents
  - 1. Record actual locations of tagged valves.
- F. Delivery, storage, and handling.

### **2. PRODUCTS**

#### **2.1 NAMEPLATES**

- A. Equipment Mark Nameplates: Laminated three-layer plastic with engraved black letters (matching equipment mark indicated on drawings) on light contrasting background color, with minimum 3/4 inch high letters.



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- B. **Equipment Nameplates:** Factory-applied permanent nameplate indicating the manufacturer's name, model, serial number, temperature and pressure design, and any other data necessary to conform with specified requirements. On equipment installed outdoors, nameplate shall be stamped steel or engrave plastic.

## 2.2 TAGS

- A. **Plastic Tags:** Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. **Chart:** Typewritten list that is plastic laminated and mounted in mechanical room. Valve list is to coordinate with mechanical piping schematics if provided on plans.
- C. **Pipe Schematics:** Valve numbers are to be labeled on Engineer schematic drawings, plastic laminated and schematic shall be mounted in mechanical room.

## 2.3 PIPE MARKERS

- A. **Color:** Conform to ASME A13.1, latest revision
- B. **Plastic Tape Pipe Markers:** Minimum 1-1/2" letter size and 2-mil thickness, flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings; minimum information indicating flow direction arrow and identification of fluid being conveyed. VOC Limit: 50 g/L.
- C. **Underground Plastic Pipe Markers:** Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service. Provide tape with printing which most accurately indicates the type of service of buried pipe.

## 2.4 DUCT MARKERS

- A. **Plastic Tape Duct Markers:** Minimum 1-1/2" letter size and 2-mil thickness, flexible, vinyl film tape with pressure sensitive adhesive backing and printed marking; minimum information indicating flow direction arrow and identification of air system being conveyed.

## 3. EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

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- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic tape pipe and duct markers in accordance with manufacturer's instructions. Directional arrow tape shall be overlapped to ensure proper adhesion and no peeling of tape in future.
- D. Identify air handling units, exhaust fans, chillers, pumps, heat generating, heat rejecting, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- E. Identify pressure reducing valves, backflow preventers, valves, and meters with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify valves in main and branch piping with tags.
- H. Tag automatic controls, instruments, and relays. Key to control schematic.
- I. Identify piping, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction, and pressure when applicable, i.e. low pressure steam, high pressure steam. Install in clear view from floor and align with axis of piping. Locations of identification not to exceed 15 feet on straight runs including risers and drops, more often in congested areas, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Provide a minimum one label per pipe per room. Where pipes are racked, install pipe markers on each pipe in the same location to aid in differentiating each pipe in the rack.
- J. Identify ductwork with plastic tape duct markers. Identify service, flow direction and pressure when applicable, i.e. low pressure supply air, high pressure supply air. Install in clear view from floor and align with centerline of duct. Locations of identification not to exceed 15 feet from straight runs including risers and drops, more often in congested areas, at each side of penetration of structure or wall, and at each obstruction. When several ducts from different units are located in concealed congested areas, locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 23 05 53

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## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

### 1. GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions apply to this section.

#### 1.2 DESCRIPTION OF WORK

- A. This scope of services specifies the requirements and procedures for mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner's personnel. It is the Contractor's responsibility to assist as outlined below.
- B. Test, adjust and balance the following mechanical systems which are shown in the construction documents.
1. Supply air systems, all pressure ranges, including variable volume and constant volume systems.
  2. Exhaust air systems.
  3. Hydronic systems.
  4. Steam distribution systems.
  5. Verify temperature control system operation.
  6. Plumbing water systems (i.e. recirculation pumps, booster pumps).
  7. **Note: As part of the LIDR commissioning process, all labs shall be tested and adjusted for airflow. Containment shall be maintained throughout failure. All air handlers in the facility shall be taken offline as part of the testing process.**
- C. The contractor's responsibilities are as follows:
1. Notify the Owner's Representative fourteen (14) days prior to the schedule date for balancing the system.
  2. Schedule a four (4) week allowance for the testing and balancing firm to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.
  3. Cooperate with the testing and balancing firm and shall make all necessary preparations for the TAB efforts.
  4. Complete the following work prior to requesting the TAB effort.
    - a. Clean and flush all piping systems.
    - b. Leak test and make tight all piping systems.
    - c. Fill all piping systems with clean water.

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- d. Clean and seal all ductwork systems.
  - e. Service and tag all equipment.
  - f. Set and align all motors and drives.
  - g. Start up and prove all equipment and systems.
  - h. Make preliminary settings on all control devices and have all systems operational.
  - i. Operate all systems successfully for twenty-four (24) hours minimum.
5. Lubricate all motors and bearings.
  6. Check fan belt tension.
  7. Check fan rotation.
  8. Patch insulation, ductwork and housing, using materials identical to those removed 9.
  9. Seal ducts and piping, and test for and repair leaks.
  10. Seal insulation to re-establish integrity of the vapor barrier.
  11. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.
  12. Provide a complete set of as-built drawings prior to the TAB effort.
  13. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.
  14. Change out fan sheaves when and if required by the TAB firm.
  15. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.
  16. If a significant rebalance (Owner's determination) of the HVAC system is required due to the Contractor's failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

1.3 PRE-BALANCING CONFERENCE A.

- A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner's representative, Engineer and the Test and Balance Agency's representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

1.4 SEQUENCING AND SCHEDULING OF SERVICES

- 1.5 Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.

**2. PART 2 – PRODUCTS**

- 2.1 PRODUCTS (Not applicable)

**3. PART 3 – EXECUTION**

TESTING, ADJUSTING, AND BALANCING

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3.1 GENERAL (Not applicable)

**END OF SECTION**

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**SECTION 23 07 13 - DUCTWORK INSULATION**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Ductwork insulation.
- B. Insulation jackets.

1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

- A. References.
- B. Submittals.
- C. Delivery, Storage, and Handling.
- D. Quality assurance.
  - 1. Materials: ASTM E84 Flame spread/smoke developed rating of 25/50 or less.
- E. Qualifications.
  - 1. Applicator: Company specializing in performing the work of this section with minimum three years experience.
- F. Environmental requirements.
  - 1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
  - 2. Maintain temperature during and after installation as recommended by the manufacturer.

**2. PRODUCTS**

2.1 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. 'K' value: ASTM C518, 0.30 at 75 degrees F.
  - 2. Maximum service temperature: 250 degrees F.
  - 3. ASTM C1104 Water Vapor Sorption less than 5% by weight



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4. Density: 1.5 lb/cu ft.

B. Vapor Barrier Jacket

1. Vapor Retarder Jacket: FSK or PSK confirming to ASTM C 1136 Type I, II.
2. Moisture vapor transmission: ASTM E96; 0.02 perm maximum.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

D. Tie Wire: Annealed steel, 16 gage (1.5 mm).

2.2 GLASS FIBER, RIGID

A. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' value: ASTM C518, 0.23 at 75 degrees F.
2. Maximum service temperature: 250 degrees F.
3. Maximum moisture absorption: less than 3 percent by volume.
4. Density (concealed locations): 3.0 lb/cu ft.
5. Density (exposed locations): 6.0 lb/cu ft.

B. Vapor Barrier Jacket

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture vapor transmission: ASTM E96; 0.02 perm.
3. Secure with pressure sensitive tape.

C. Vapor Barrier Tape

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive acrylic based adhesive.

2.3 CELLULAR FOAM

A. Insulation: ASTM C534; flexible, cellular elastomeric, sheet.

1. 'K' ('ksi') Value: ASTM C177 or C518; 0.27 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.

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4. Maximum Moisture Absorption: ASTM D209; 0.2 percent by volume.
5. Moisture Vapor Transmission: ASTM E96; 0.08 perm-inches.
6. Maximum Flame Spread: ASTM E84; 25.
7. Maximum Smoke Developed: ASTM E84; 50.
8. Connection: Waterproof vapor barrier adhesive.

- B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

### 3. EXECUTION

#### 3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

#### 3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- C. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- D. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- E. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
- F. Secure insulation without vapor barrier with staples (staples only work well when there is a facing present), tape, or wires.
- G. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
- H. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
- I. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- J. Do not overtighten and/or compress flexible glass fiber duct insulation.

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- K. At duct access doors or other openings, insulation shall be properly framed and finished.

3.3 GLASS FIBER DUCTWORK INSULATION SCHEDULE

Ductwork Application:	Type:	Thickness:	Vapor Barrier Required (Y/N):
Exposed rectangular and round supply air duct upstream of terminal units	Flexible	2"	Y
Exposed rectangular supply air duct downstream of terminal units	Flexible	2"	Y
Exposed round supply air duct downstream of terminal units	Flexible	2"	Y
Concealed rectangular and round supply air duct upstream of terminal units	Flexible	2"	Y
Concealed rectangular supply air duct downstream of terminal units	Flexible	2"	Y
Concealed round supply air duct downstream of terminal units	Flexible	2"	Y
Exposed rectangular and round exhaust air duct	None required unless shown on plans		
Concealed rectangular and round exhaust air duct	None required unless shown on plans		

Schedule Notes:

- A. All ductwork in mechanical rooms shall be insulated as though it were "Exposed".

END OF SECTION 23 07 13

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**SECTION 23 07 19 – HVAC PIPING INSULATION**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

- A. Quality assurance.
  - 1. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, and UL 723.
- B. References.
- C. Submittals.
- D. Operation and maintenance manuals.
- E. Project record documents.
- F. Environmental requirements
  - 1. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
  - 2. Maintain temperature during and after installation for minimum period of 24 hours.

**2. PRODUCTS**

2.1 GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  - 1. 'k' ((btu\*in)/(hr\*ft<sup>2</sup>\*deg F)) value : ASTM C335

Temperature (degrees F)	Maximum 'k' value (btu*in)/(hr*ft <sup>2</sup> *deg F)
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75	0.23
100	0.24
150	0.25
200	0.28
300	0.34
400	0.42
500	0.51

2. Minimum Service Temperature: 0 degrees F.
3. Maximum Service Temperature: 1000 degrees F.
4. Maximum Moisture Absorption: 0.2% by volume.

B. Vapor Barrier Jacket

1. ASTM C1136, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perms.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

C. Vapor Barrier Lap Adhesive: MIL-A-3316C, Class 2, Grade A compliant. Compatible with insulation. VOC Limit 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Insulating Cement: ASTM C195; hydraulic setting on mineral wool. VOC Limit 70 g/L (multipurpose construction adhesive).

E. Fibrous Glass Fabric: Cloth, untreated; 9 oz/sq yd weight with 1.0 lb/cu ft density blanket.

F. Indoor Vapor Barrier Finish: Vinyl emulsion type acrylic, compatible with insulation, white color. VOC Limit 50 g/L.

2.2 CELLULAR FOAM

A. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.

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1. 'k' ((btu\*in)/(hr\*ft<sup>2</sup>\*deg F)) value: ASTM C177 or C518; 0.21 to 0.27 at 75 degrees F mean temperature rating.
  2. Minimum Service Temperature: -20 degrees F.
  3. Maximum Service Temperature: 180 degrees F.
  4. Maximum Moisture Absorption: ASTM C209; 0.2 percent by volume.
  5. Moisture Vapor Transmission: ASTM E96; 0.08 perm inches.
  6. Maximum Flame Spread: ASTM E84; 25.
  7. Maximum Smoke Developed: ASTM E84; 50.
  8. Connection: Waterproof vapor barrier adhesive.
  9. Provide documentation indicating that product contains no urea formaldehyde.
  10. Fittings: Pre-fabricated closed cell fittings of like material and thickness as adjacent pipe insulation.
  11. In all exposed finished areas without jacketing, provide white insulation, otherwise use black.
- B. Elastomeric Foam Adhesive: MIL-A-24179A, Type II, Class I, compliant. Air dried, contact adhesive, compatible with insulation. VOC Limit: 50 g/L or less when calculated according to 40 CFR 59, Subpart D.

## 2.3 INSULATION BLANKETS FOR STEAM AND CONDENSATE FLANGED VALVES AND EXPANSION JOINTS

- A. Insulation: Tight-fitting, reusable insulation blanket consisting of high-density insulation (fiberglass, mineral wool, ceramic fiber) covered on outside with coated glass fabric having heavy adjustable straps with buckles. Inside of blanket shall be covered with fabric suitable to specified temperature of stainless steel square mesh woven wire cloth. Insulation shall be a minimum of 1-1/2" thick and shall be suitable for temperatures up to 500 Deg. F.

## 2.4 JACKETS

A. PVC Plastic

1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, white color.
  - a. Minimum Service Temperature: 0 degrees F.
  - b. Maximum Service Temperature: 150 degrees F.
  - c. Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
  - d. Maximum Flame Spread: ASTM E84; 25.
  - e. Maximum Smoke Developed: ASTM E84; 50.
  - f. Thickness: 20 mil.
  - g. Connections: Brush on welding adhesive or pressure sensitive color matching vinyl tape.

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2. Covering Adhesive Mastic: Compatible with insulation and PVC jacket. VOC Limit 50 g/L according to 40 CFR 59, Subpart D (EPA Method 24).

B. Aluminum Jacket: ASTM B209.

1. Thickness: 0.040 inch.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: PVC pre molded fittings.
5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

**3. EXECUTION**

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Painting of cellular foam insulation is not allowed.**
- C. On exposed piping, locate insulation and cover seams in least visible locations. For cellular foam insulation tape ALL visible seams with tape matching insulation color.
- D. Fiberglass insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  1. Provide vapor barrier jackets, factory applied or field applied.
  2. Insulate fittings, joints, flanges, unions, strainers, flexible connectors, and valves with molded insulation of like material and thickness as adjacent pipe. PVC or aluminum covers are required in all exposed locations as in mechanical rooms.
  3. Finish with glass cloth and vapor barrier adhesive.
  4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  5. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Cellular foam insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

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1. Insulate fittings, joints, flanges, unions, strainers, flexible connectors, and valves with molded insulation of like material and thickness as adjacent pipe. PVC or aluminum covers are required in all exposed locations as in mechanical rooms.
  2. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  3. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- F. Fiberglass insulated pipes conveying fluids above ambient temperature:
1. Provide vapor barrier jackets, factory applied or field applied.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. PVC covers are required in all exposed locations.
  3. Finish with glass cloth and adhesive.
  4. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  5. For hot piping conveying fluids, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
  6. For steam and condensate piping, insulate flanges and unions.
- G. Inserts and Shields:
1. Refer to Section 23 05 29 for additional information.
  2. Application: Piping 1 inch diameter or larger.
  3. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  4. Insert Location: Between support shield and piping and under the finish jacket.
  5. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  6. Insert Material: ASTM C640 cork, hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
  7. Provide inserts and/or shields per manufacturer recommendations for cellular foam insulation applications in order to maintain continuous insulation throughout the pipe system. The removal of sections of cellular foam insulation to accommodate pipe supports is not acceptable. Manufacturer products specifically designed for supporting insulation and maintaining the integrity of the insulation system at pipe hanger locations, such as Armaflex Armafix Insulation Pipe Hangers, are acceptable.
- H. Finish insulation at supports, protrusions, and interruptions.
- I. For pipe exposed below 10 feet above finished floor, finish with PVC jacket and PVC fitting covers.
- J. For piping exposed in mechanical rooms below 10 feet above finished floor, finish with aluminum jacket and aluminum fitting covers.



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- K. All valves in insulated systems shall have valve stem extensions. Insulation installer shall notify the contractor and Owner if valves without stem extensions are encountered. All valves without stem extensions in areas where stem extensions are required shall be replaced.
- L. Install insulation blanket on steam and condensate valves.
- M. **Provide insulation clearance and access to valves and fittings in hangers and from structure and other equipment. Insulation shall be continuous through all hangers and supports. Refer to Section 23 07 19.**

3.3 GLASS FIBER INSULATION SCHEDULE

A. Heating Systems

<u>PIPING SYSTEM:</u>	<u>PIPE SIZE:</u>	<u>THICKNESS:</u>
Heating Water Supply and Return	1-1/4" & smaller	1-1/2"
Heating Water Supply and Return	1-1/2" & larger	2"
Air Terminal Unit Reheat Coil Return Bends	1-1/4" & smaller	1-1/2"
Air Terminal Unit Reheat Coil Return Bends	1-1/2" & larger	2"
Low Pressure Steam & Steam Condensate (less than or equal to 15 PSIG)	3" & smaller	2-1/2"
Low Pressure Steam & Steam Condensate (less than or equal to 15 PSIG)	4" & larger	3"
Med./High Pressure Steam & Steam Cond. (greater than 15 PSIG)	3/4" & smaller	3"
Med./High Pressure Steam & Steam Cond. (greater than 15 PSIG)	1-1/4" & 1"	4"
Med./High Pressure Steam & Steam Cond. (greater than 15 PSIG)	1-1/2" & larger	4-1/2"
Condensate Pump Steam Vent	All sizes	2"
Steam Vent	All sizes	2-1/2"
Warm Drains (above ambient)	1-1/4" & smaller	1"
Warm Drains (above ambient)	1-1/2" & larger	1-1/2"

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Piping Exposed to Freezing w/ Heat Tracing (Provide with stainless steel metal jacket in outside conditions)	All sizes	1"
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3.4 CELLULAR FOAM INSULATION SCHEDULE

A. Cooling Systems

<u>PIPING SYSTEM:</u>	<u>PIPE SIZE:</u>	<u>THICKNESS:</u>
Chilled Water	All sizes	1"
Cold Condensate Drains (below ambient)	All sizes	1"
Refrigerant Suction Line	All sizes	1-1/2"
Refrigerant Liquid Line (in spaces 120 degrees and greater)	All sizes	1-1/2"
Fan Coil Unit Condensate	All sizes	1"

END OF SECTION 23 07 19

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## **SECTION 230800 - MECHANICAL COMMISSIONING REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 WORK INCLUDES**

- A. Validation of proper installation of Division 23 systems and equipment
- B. Systems and equipment testing and startup
- C. Equipment performance verification
- D. Functional testing of control systems
- E. Documentation of tests, procedures and installations

#### **1.2 SCOPE INCLUDES**

- A. Systems to be commissioned include the following:
  - 1. Rooftop Unit Systems
  - 2. Dedicated Outdoor Air Systems
  - 3. Exhaust Systems
  - 4. Heat Recovery System
  - 5. Variable Refrigerant Flow Systems
  - 6. Energy Management and Control Systems
    - a. Building Automation System
  - 7. Life Safety Systems
    - a. HVAC Equipment Shutdown via Fire Alarm

#### **1.3 RELATED DOCUMENTS**

- A. Commissioning Plan - This plan is part of the Contract Documents and outlines many responsibilities, procedures and tasks throughout the commissioning process.
- B. Section 019113 – General Commissioning Requirements
- C. Section 260800 – Electrical Commissioning Requirements
- D. Division 23 Sections - Individual Sections stipulate installation, startup, warranty and training requirements for the system or device specified in that Section.

#### **1.4 REFERENCES**

- A. ASHRAE Guideline 0-2013: The HVAC Commissioning Process.
- B. ANSI/NEBB S110-2019 - Whole Building Technical Commissioning of New Construction

#### 1.5 GENERAL DESCRIPTION

- A. Commissioning is a process to assure all building systems are installed and perform interactively according to the design intent; the systems are efficient, cost effective and meet the Owner's operational needs; the installation is adequately documented. Commissioning serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance building systems from installation to fully optimized operation.
- B. The Commissioning Authority will work with the Contractor and Design Engineer to coordinate, oversee, and document the commissioning process during the Construction Phase of this project.
- C. This Section defines responsibilities of the Contractor to facilitate the commissioning process particularly during the Construction Phase of the project.

#### 1.6 DEFINITIONS

- A. Refer to specification section 019113 for definitions related to the commissioning process.

#### 1.7 DOCUMENTATION

- A. Contractor shall send Commissioning Authority one copy of the following per the procedures specified in other sections of the Specification:
  - 1. Shop drawings and product data related to systems and equipment to be commissioned on this project. CxA will review and incorporate comments via the Design Engineer.
  - 2. Initial draft of equipment startup plan checklists along with manufacturers' startup procedures. CxA will assist in development and recommend approval.
  - 3. System Test Reports. CxA will review and compile prior to FPT.
  - 4. System certificate of readiness including completed equipment startup forms along with the manufacturers' field or factory performance test documentation. CxA will review and approve prior to FPT.
  - 5. Completed Test and Balance Reports. CxA will review and approve prior to FPT.

#### 1.8 SEQUENCING AND SCHEDULING

- A. Systems can be in various stages of the commissioning process where appropriate, in order to expedite close out of the facility. The CxA and Contractor shall cooperate to schedule Cx tasks to minimize the duration of Cx activities. Sequential priorities shall be followed per the Cx Plan.

- B. Commissioning Schedule - Contractor shall incorporate the commissioning process into the project schedule. Startup, TAB and FPT shall be itemized as applicable for each system. Durations for each task shall be coordinated with the CxA.

## 1.9 COORDINATION MANAGEMENT PROTOCOLS

- A. Coordination responsibilities and management protocols relative to Cx are initially defined in the Cx Plan but will be refined and documented at the commissioning scoping meeting. Contractor shall have input to the protocols and all parties will commit to scheduling obligations. The CxA will record and distribute notes from the meeting.

## 1.10 CONTRACTOR RESPONSIBILITIES

- A. Construction Phase
  1. Include commissioning requirements in price and plan for work.
  2. Attend scoping and coordination meetings scheduled by the CxA.
  3. Remedy deficiencies identified during the construction period.
  4. Prepare and submit required draft forms and equipment information requested by the CxA. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
  5. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  6. Provide limited assistance to the CxA in preparing the specific functional performance test procedures. Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
  7. Thoroughly complete and inspect installation of systems and equipment in accordance with the Contract Documents, reference or industry standards, and specifically Part 3 of this Section.
  8. Startup systems and equipment prior to verification and performance testing by the CxA. Startup procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part 3 of this Section.
  9. Record startup and test procedures on startup forms and checklists and certify the systems and equipment have been started and tested in accordance with the Contract Documents, reference or industry standards, and specifically Part 3 of this Section. Each form shall be signed and dated by the individual responsible for the startup or test.

10. Complete pre-approved startup checklists and submit along with other installation certification documentation such as certificate of readiness, warranties, test results, etc.
11. Schedule and coordinate Cx efforts required by appropriate subcontractors and vendors.
12. Demonstrate the systems as specified.
13. Certify systems have been installed and are operating per Contract Documents through certificates of readiness.
14. Maintain an updated set of record documentation.
15. Copy CxA on indicated documentation.

B. Acceptance Phase

1. Assist CxA in verification and performance testing. Assistance will generally include the following:
  - a. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
  - b. Manipulate systems and equipment to facilitate testing.
  - c. Manipulate control systems to facilitate verification and performance testing.
2. Correct any work not in accordance with Contract Documents and non-conformances included in the commissioning issues log.

C. Warranty Phase

1. Provide warranty service.
2. Correct any deficiencies identified.
3. Update record documentation to reflect any changes made throughout the Warranty Phase.

#### 1.11 CONTROLS CONTRACTOR RESPONSIBILITIES

A. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:

1. All interactions and interlocks with other systems.
2. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
3. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
4. Start-up sequences.

5. Warm-up mode sequences.
  6. Normal operating mode sequences.
  7. Unoccupied mode sequences.
  8. Shutdown sequences.
  9. Capacity control sequences and equipment staging.
  10. Temperature and pressure control: setbacks, setups, resets, etc.
  11. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
  12. Effects of power or equipment failure with all standby component functions.
  13. Sequences for all alarms and emergency shut downs.
  14. Seasonal operational differences and recommendations.
  15. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
  16. Schedules, if known.
  17. Include commissioning requirements in price and plan for work.
- B. Assist and cooperate with the CxA in the following manner:
1. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls. Assist in the functional testing of all equipment specified in Part 3 of this specification.
  2. Execute all control system trend logs specified in Part 3 of this specification.

#### 1.12 CONTRACTOR NOTIFICATION

- A. Contractor shall completely install, thoroughly inspect, startup, test adjust and balance systems and equipment. All activities shall be documented on specified forms. Contractor shall notify Design Engineer, Owner and CxA via the certification of readiness that systems are complete and ready for verification and functional performance testing.
- B. Contractor shall notify CxA at least 10 business days in advance of any tests or startups. CxA shall witness selected tests and startups.

#### 1.13 STARTUP CHECKLISTS

- A. Startup checklists for each type of equipment and system shall be submitted to CxA for approval prior to startup. The forms shall be designed by the appropriate subcontractors or vendors to meet the requirements of the Contract Documents. Forms shall be developed for the specific equipment being installed for this project.
- B. Startup checklists shall generally include the following for each (as applicable):
  1. Project specific designation, location and service



2. Pertinent nameplate data
  3. Indication of the party performing the test
  4. Field for signature of the startup technician along with the date
  5. Clear explanation of the observation, test, measurement, etc. with a pass/fail indication and a record of measurement parameters
  6. Checklist space indicating all O&M instructions, warranties, and record documents have been completed and submitted.
  7. Checklist space that proper maintenance clearances have been maintained
  8. Checklist space indicating that any required special tools and/or spare tools were turned over to the Owner
  9. Checklist space indicating that required prerequisite equipment and systems were successfully started.
- C. Startup checklists shall incorporate the manufacturer-specified procedures. Contractor shall compile the startup and checkout procedures indicated in the manufacturer's documentation prior to designing the forms. Include specified acceptance criteria as applicable. The manufacturer's startup and checkout procedures shall be submitted to the CxA along with the draft startup checklists.
- D. Completed startup plans for all pieces of equipment included in a system shall be submitted to CxA prior to verification and performance testing.
- E. See specification 019113 for additional information regarding Startup and Prefunctional Checklists.

#### 1.14 FUNCTIONAL PERFORMANCE TESTING

- A. Participation: CxA will coordinate, test and/or witness functional performance tests after the successful startup and documentation of systems and equipment is complete. Contractor shall assist, as described above, with manipulation of the systems or equipment; provision of supporting equipment or materials (lifts, ladders, specialty test equipment, etc.); and on the spot remediation of minor identified deficiencies.
- B. Detailed Test Forms: CxA will prepare detailed testing procedures and forms to conduct and document the FPT. These will be developed during the Construction Phase and completed during the Acceptance Phase.
- C. Completeness: All systems must be complete and ready for FPT. TAB work must be complete and the control systems must be tested and started for the respective system or component.
- D. Test Documentation: CxA will record test results on the forms developed for the testing. CxA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly indicate when the test has failed. CxA shall recommend acceptance of the system or component after all related testing is successfully complete.
- E. Deficiencies and Retesting: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can

continue to successful completion. Significant deficiencies will fail the test and require retesting of the affected portions of the test. The CxA will subsequently track the resolution of the deficiency via the Project Deficiency List. All tests shall be repeated until successful completion.

## PART 2 PRODUCTS (Not Used)

## PART 3 EXECUTION

### 3.1 GENERAL

- A. This Section outlines specific startup, checkout, and functional testing requirements for systems and equipment. Generally, these procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct. These requirements along with those specified in the individual Section provide a minimum guideline for development of startup procedures, checklists and tests. Contractor shall synthesize these requirements with that of the manufacturer's and/or applicable codes and standards to develop specific and itemized startup procedures specific to that installed on this project.
- B. Refer to all Division 23 Specifications for tests performed on installed equipment and systems.

### 3.2 STARTUP

- A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 019113. The Contractor has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning authority or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA, Contractor, and Owner. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all startup plan checklists as soon as possible.

### 3.3 VALVES – STARTUP/CHECKOUT

- A. Operate all valves, manual and automatic, through their full stroke. Ensure smooth operation through full stroke and appropriate sealing or shutoff.
- B. Verify actuators are properly installed with adequate clearance.

### 3.4 METERS AND GAUGES – STARTUP/CHECKOUT

- A. Adjust faces of meters and gages to proper angle for best visibility.
- B. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint. For meters and gauges requiring temporary manual connection of read-out device, such as pressure taps on a flow measuring device, ensure threads are clean and that connection can be made easily.
- C. Meters and gauges requiring manual connection of readout device shall be installed with adequate access to allow connection of device with normal tools.

### 3.5 MECHANICAL IDENTIFICATION – STARTUP/CHECKOUT

- A. Verify all valve tags, piping, duct and equipment labeling corresponds with drawings and indices and meets required Specifications. Correct any deficiencies for all piping and duct systems.
- B. Adjusting: Relocate any mechanical identification device that becomes visually blocked by work from this Division or other Divisions.
- C. Cleaning: Clean face of identification devices and frames of valve charts.

### 3.6 MECHANICAL INSULATION – STARTUP/CHECKOUT

- A. Examine all systems and equipment that are specified to be insulated. Patch and repair all insulation damaged after installation. Ensure the integrity of vapor barrier around all cold surfaces.

### 3.7 PIPING – STARTUP/CHECKOUT

- A. This applies to all piping systems installed including underground site utilities.
- B. Inspect all piping for proper installation; adequate support with appropriate vibration isolation where applicable; and adequate isolation valves for required service.
- C. Flush all piping and clean all strainers.
- D. Ensure adequate drainage is provided at low points and venting is provided at high points. Ensure air is thoroughly removed from the system as applicable.
- E. Ensure all piping is adequately supported and anchored to allow expansion. Bump across the line pumps and inspect for excessive pipe movement.
- F. Pressure and/or leak test all applicable systems in accordance with requirements in Specifications, ASME B31.1, and B31.9 as applicable.
- G. Sterilize applicable piping systems as specified and as required by regulatory authorities.
- H. Submit reports that document the testing results with certification of the results.

- I. Verify the operation of safety relief valves, operating controls, safety controls, etc. to ensure a safe installation.
- J. Set and adjust fill pressure and level controls to the required setting.

### 3.8 AC MOTORS – STARTUP/CHECKOUT

- A. Verify proper alignment, installation and rotation.
- B. Measure insulation resistance, phase balance, and resistance to ground.
- C. Verify properly sized overloads are in place.
- D. Measure voltage available to all phases. Measure amps and RPM after motor has been placed in operation under load.
- E. Record all motor nameplate data.

### 3.9 VARIABLE SPEED DRIVES – STARTUP/CHECKOUT

- A. General: Provide the services of a factory-authorized representative to test and inspect equipment installation, provide startup service and to demonstrate and train Owner's personnel.
- B. Startup Checks: Perform the following checks before startup and as specified in manufacturer's startup instructions:
  - 1. Check for shipping damage.
  - 2. Perform a point-to-point continuity test for all field installed wiring interconnections. Verify terminations of field installed wiring.
  - 3. Check for proper torque on connections.
  - 4. Verify use of shielded cable where specified and check that shields have been terminated properly.
  - 5. Verify grounding.
  - 6. Check motor nameplate against drive input rating.
  - 7. Manually rotate motor shaft to ensure free rotation.
  - 8. Check that motor leads are not grounded.
- C. Starting Procedures: Follow the manufacturer's written procedures with the following as a minimum:
  - 1. Ensure device and system which drive is serving is configured to withstand the device operation specified below.
  - 2. Adjust the minimum voltage to enable starting but not to draw excessive power at start.
  - 3. Adjust the Volts/Hz to proper setting.
  - 4. Adjust the acceleration and deceleration rates to the specified times.

5. Adjust current limiting to coordinate with the overcurrent device and protect the motor.
6. Set the maximum and minimum speed.
7. Manually ramp fan speed from minimum to maximum and check for excessive noise and vibration.
8. Determine any critical speeds to avoid and set these in the drive.
9. Verify proper motor rotation in both, Normal and Bypass (if applicable) modes.
10. Record the motor terminal voltage.
11. Verify and document proper setup of redundant drives.
12. Verify and document proper operation of bypasses.

### 3.10 INDOOR AIR HANDLING UNITS – STARTUP/CHECKOUT

- A. Inspect the field assembly of components and installation of indoor air handling units (AHU) including piping, ductwork and electrical connections.
- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum fan wheel, fan cabinet, and coils entering air face. Ensure volatile irritants are contained and kept out of occupied spaces.
- C. Adjust and lubricate dampers and linkages for proper damper operation.
- D. Ensure field fabricated unit sections are properly connected within acceptable tolerances.
- E. Seal all penetrations air tight and ensure access doors seat tightly.
- F. Verify unit is secure on mountings and supporting devices and connections for piping, ductwork and electrical are complete.
- G. Verify proper thermal overload protection is installed in motors, starters and disconnects.
- H. Ensure vibration isolation integrity and the connections to it are maintained throughout the AHU installation.
- I. Refer to AC Motors in this Section.
- J. Disconnect fan drive from motor and verify proper motor rotation direction; verify fan wheel free rotation; and verify smooth bearing operations. Reconnect fan drive system, align belts and install belt guards. Rotation shall be checked with VFD operating in normal and bypass modes (if applicable).
- K. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.
- L. Comb coil fins for parallel orientation.
- M. Install clean filters.

- N. Ensure condensate drains properly and trap is adequate.
- O. Stroke all valves and dampers to ensure free and full travel.
- P. Pressure test units as required in the Specification.
- Q. Refer to Section 230990 Testing, Adjusting, and Balancing for detailed requirements for testing, adjusting, and balancing air handling systems.
- R. Refer to Section 230900 HVAC Instrumentation and Controls for detailed requirements for starting the controls related to the air handling systems.

### 3.11 FANS – STARTUP/CHECKOUT

- A. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum fan wheel, fan cabinet and coils entering air face. Ensure volatile irritants are contained and kept out of occupied spaces.
- C. Adjust and lubricate dampers and linkages for proper damper operation.
- D. Verify unit is secure on mountings and supporting devices and connections for ductwork and electrical are complete.
- E. Verify proper thermal overload protection is installed in motors, starters and disconnects.
- F. Ensure vibration isolation integrity and the connections to it are maintained with the fan installation.
- G. Refer to AC Motors in this Section.
- H. Disconnect fan drive from motor and verify proper motor rotation direction; verify fan wheel free rotation; and verify smooth bearing operations. Reconnect fan drive system, align belts and install belt guards. Rotation shall be checked with VFD operating in normal and bypass modes (if applicable).
- I. Lubricate bearings, pulleys, belts and other moving parts with factory-recommended lubricants.
- J. Stroke all dampers to ensure free and full travel.
- K. Refer to Section 230990 Testing, Adjusting, and Balancing for detailed requirements for testing, adjusting, and balancing fans.
- L. Refer to Section 230900 HVAC Instrumentation and Controls for detailed requirements for starting the controls related to the fans.

### 3.12 METAL DUCTWORK – STARTUP/CHECKOUT

- A. Leakage Tests: Refer to Section 233113 Ductwork for duct testing requirements.
- B. Clean ductwork internally of dust and debris unit by unit as it is installed. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or where ductwork is to be painted might interfere with painting or cause paint deterioration.
- C. Strip protective paper from stainless ductwork surfaces and repair finish wherever it has been damaged.
- D. Temporary Closure: Provide temporary closure at ends of ducts, which are not connected to equipment or air distribution devices at time of ductwork installation. Use polyethylene film or other covering that will prevent entrance of dust and debris until connections are completed.
- E. Balancing: Refer to Section 230990 Testing, Adjusting, and Balancing for air distribution balancing of metal ductwork. Seal any leaks in ductwork that become apparent in balancing process.

### 3.13 DUCTWORK ACCESSORIES – STARTUP/CHECKOUT

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leak proof performance.
  - 1. Adjusting: Adjust ductwork accessories for proper settings. Install fusible links in fire dampers and adjust for proper action.
  - 2. Label access doors in accordance with Division 23 specification sections.
  - 3. Mark final positioning of manual dampers as specified in Section 230990 Testing, Adjusting, and Balancing.
- B. Fire Damper Testing: For every fire damper, remove the fusible link and verify the damper operates freely and closes tightly. Reinstall the fusible link.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

### 3.14 CONTROL SYSTEMS – STARTUP/CHECKOUT

- A. Startup: Refer to Section 230900 HVAC Instrumentation and Controls. This Specification generally requires manufacturer's authorized representative to startup, test, adjust and calibrate DDC control systems and demonstrate compliance with requirements. This includes verification of sequences, normal and emergency operations, calibration, interfaces, interlocks, etc.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

### 3.15 SAV/EAV TERMINAL UNITS – STARTUP/CHECKOUT

- A. Ensure unit is properly supported and that integrity of vibration isolation has been maintained where applicable.
- B. Ensure the air velocity sensor is correctly installed and that inlet/outlet restrictions for accurate measurements have been met.
- C. Ensure air inlet is free of obstructions. Start fans and ensure proper rotation (as applicable).
- D. Measure and record motor amperage and voltage (as applicable).
- E. Install new filters where required.
- F. Calibrate and adjust the airflow control parameters. Set applicable minimum and maximum setpoints. Coordinate with the Building Management System (BMS) contractor as necessary to obtain flow parameters.
- G. Check the heating device and control to ensure functionality and proper installation. Check stroke and range on the valve and ensure it closes and seals tightly. Ensure the coils are undamaged, combed, and vented.
- H. Refer to Section 230593 Testing, Adjusting, and Balancing and coordinate work.

### 3.16 BOILERS – STARTUP/CHECKOUT

- A. Inspect the field assembly of components and installation of boilers including piping, flue, and electrical connections.
- B. Verify unit is secure on mountings, supporting devices, and connections for piping, flue, and electrical are complete.
- C. Verify adequate access for maintenance.
- D. Check power and control voltage

### 3.17 PUMPS – STARTUP/CHECKOUT

- A. Check suction line connections for tightness to avoid drawing air into the pump.
- B. Clean and lubricate all bearings.
- C. Refer to AC Motors in this Section.
- D. Check that pump is free to rotate by hand. Pump shall be free to rotate with the pump hot and cold for pumps handling hot liquids. If the pump is bound or even drags slightly do not operate the pump until the cause of the trouble is determined and corrected.
- E. Check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing. Rotation shall be checked with VFD operating in normal and bypass modes (if applicable).



- F. Clean associated strainers.
- G. Once system flush is complete, remove startup strainers and affix to adjacent piping to allow confirmation of removal.
- H. Check that the proper overloads have been installed in the starter and are the correct size.
- I. Verify that the integrity of the vibration isolation is maintained throughout the support and the connections.
- J. Align pump within manufacturer's recommended tolerances.
- K. Ensure all associated piping has been cleaned, tested, and vented.
- L. Start the pump per the manufacturer's instructions.
- M. Check the general mechanical operation of the pump and motor.
- N. Verify that all thermometers and gauges are installed, are clean and undamaged, and are functional.
- O. Verify the check valve seal is appropriate.
- P. Check noise and vibration levels and ensure they are within the manufacturer's recommended tolerances.
- Q. Refer to Section 230593 Testing, Adjusting and Balancing for detailed requirements for testing, adjusting and balancing hydronic systems.
- R. Check the Net Positive Suction Head (NPSH) is within allowable limits for the operating condition.

### 3.18 FUNCTIONAL TESTING

- A. This section specifies the functional testing requirements for Division 23 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the Contractors. The general functional testing process, requirements and test method definitions are described in Section 019113. The test requirements for each piece of equipment or system contain the following:
  - 1. The contractors responsible to execute the tests, under the direction of the CxA
  - 2. A list of the integral components being tested
  - 3. Startup plan checklists associated with the components
  - 4. Functions and modes to be tested
  - 5. Required conditions of the test for each mode
  - 6. Special procedures
  - 7. Required methods of testing
  - 8. Required monitoring

9. Acceptance criteria
10. Sampling strategies allowed

**B. PREREQUISITES**

The following applicable generic prerequisite checklist items are required to be completed and submitted with the equipment/system certificate of readiness and checked off by CxA prior to functional testing.

1. All related equipment has been started up and startup plan checklists submitted and approved ready for functional testing.
2. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.
3. Piping system flushing complete and required report approved
4. Water treatment system complete and operational
5. Test and balance (TAB) complete and approved for the air and hydronic systems
6. All A/E punchlist items for this equipment corrected
7. Schedules and setpoints provided to the CxA
8. False loading equipment, system and procedures ready.
9. Sufficient clearance around equipment for servicing

**C. MONITORING**

1. Monitoring is a method of testing as a stand-alone method or to augment manual testing.
2. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed herein at no extra charge.
3. Trend output data must be in a spreadsheet file (Excel or similar) with time continuous down left column and point values in column(s) to the right.
4. All trends for points of a group must start at the same moment in time, unless specifically approved otherwise with the commissioning agent.

**3.19 INDOOR AIR HANDLING UNITS (AHU)**

**A. Parties Responsible to Execute Functional Test**

1. Controls contractor: operate the controls to activate the equipment as needed.
2. HVAC mechanical contractor or vendor: assist in testing sequences as needed.
3. Electrical contractor: perform loss of power testing
4. Fire alarm contractor: assist in testing sequences as needed.
5. CxA: to witness, direct and document testing.

- B. Integral Components or Related Equipment Being Tested
  - 1. Unit and components (fans, coils, valves, ducts, VFD)
  - 2. Heat recovery coil, humidifier or evaporative cooling sections
  
- C. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.20.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.
  
- D. Functions / Modes Required to Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

<u>Function / Mode</u>	<u>Test Method</u> Manual, Monitoring, Either or Both <sup>3</sup>	<u>Required</u> <u>Seasonal</u> <u>Test</u> <sup>1</sup>
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks with which it is associated.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Supply air & reset temperature control functions.	Both	Both
3. SF and exhaust fan interlocks.	Either	
4. No Cooling when there is Heating	Both	
5. Duct static pressure (SP) control.	Both	
6. Exhaust fan tracking and building SP.	Monitoring	Both
7. VFD operation on SF: modulation to minimum, control system PID, constancy of static pressure, verification of program settings, alarms, etc.	Both	<sup>2</sup>
8. Damper interlocks and correct modulation in all modes	Manual	
9. Temperature difference across HC & CC per specifications.	Manual	
10. Heating and cooling coils freeze protection.	Manual	<sup>2</sup>
11. Night low limit, morning warmup cycle.	Either	Both
12. Heat recovery operation.	Monitoring	Both
13. Verify TAB reported SF cfm with control system reading.	Manual	<sup>2</sup>
14. All alarms (low limits, high static, etc.).	Manual	
15. Sensor and actuator calibration checks: Duct static pressure sensor, SAT, MAT, OSAT, OSA & RA damper and valve positions, SF cfm reading with TAB, and other random checks (BAS readout against hand-held calibrated instrument or observation must be within specified tolerances)	Manual	
16. Verify schedules and setpoints to be reasonable, appropriate, and coordinated with the Owner's Project Requirements.		

<sup>1</sup>Design cooling season, heating season or both. “Design” means within 5° of season design or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.

<sup>2</sup>Seasonal test not required if seasonal conditions can be adequately simulated.

<sup>3</sup>Refer to Special Procedures

E. Special Procedures or Conditions

1. None

F. Required Monitoring

1. All points listed below that are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. Refer to the Monitoring section at paragraph 3.20.C for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend
For each AHU being tested:		
OAT / RAT	10	7 days
SAT and SAT setpoint	10	7 days
PHC / CC / HC LAT	10	7 days
SF speed, if variable, else status	10	7 days
EF speed, if variable, else status	10	7 days
Duct SP and SP setpoint	10	7 days
Building / Space differential pressures	10	7 days
PHV / CCV / HCV / HUV position	10	7 days
Space temperature	10	7 days
Space relative humidity	10	7 days
SA relative humidity	10	7 days

G. Acceptance Criteria

1. For the conditions, sequences and modes tested, the AHU, integral components, and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. AHU with supporting systems shall be able to maintain the SA temperature within 1.0°F of either side of the deadband of the current setpoint without excessive hunting.
3. AHU and controls shall control the duct static pressure/airflow so that it does not drift more than an amount equal to 10% of the setpoint value to either side of the deadband without excessive hunting.
4. Space temperatures shall average within +/- 1°F of setpoint and always remain within 1°F of the ends of the deadband without excessive hunting of coil valve/heating demand, or complaints of drafts or stuffiness from occupants.
5. Space relative humidity shall average between +/- 5% RH of seasonal setpoint.
6. AHU system and controls shall maintain the space temperature and humidity within the parameters defined in the Contract Documents.

END OF REQUIREMENTS FOR AHU TEST

3.20 EXHAUST FANS FPT

- A. Parties Responsible to Execute Functional Test
  - 1. Controls contractor: operate the controls to activate the equipment, if BAS controlled.
  - 2. HVAC mechanical contractor or vendor: assist in testing sequences.
  - 3. CxA: to witness, direct and document testing.
- B. Integral Components or Related Equipment Being Tested
  - 1. Exhaust fans
- C. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.20.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.
- D. Functions / Modes Required to Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

<u>Function / Mode</u>	<u>Test Method</u> Manual, Monitoring, Either or Both <sup>1</sup>	<u>Required</u> <u>Seasonal</u> <u>Test</u>
General		
1. Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:		
2. Verify schedules and setpoints to be reasonable, appropriate, and coordinated with the Owner's Project Requirements		
3. Function at fire alarm (off, depressurization, etc.)	Manual	
4. Interlocks to building pressurization control	Manual	
5. Speed controls	Either	
6. Sensor calibration checks on any controlling temperature or pressure sensor	Manual	

<sup>1</sup>Refer to Special Procedures

- E. Special Procedures or Conditions
  - 1. None
- F. Required Monitoring

1. All points listed below which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. Refer to the Monitoring section at paragraph 3.20.C for additional monitoring details

Point	Time Step (min.)	Minimum Time Period of Trend
For each fan:		
EF speed, if variable, else status	10	7 days
Space/building pressure	10	7 days
Space temperature (if applicable)	10	7 days

G. Acceptance Criteria

1. For the conditions, sequences and modes tested, the fans, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

END OF REQUIREMENTS FOR EXHAUST FAN TEST

3.21 HEATING HOT WATER SYSTEM FPT

A. Parties Responsible to Execute Functional Test

1. Controls contractor: operate the controls, as needed.
2. HVAC mechanical contractor or vendor: assist in testing sequences.
3. Electrical contractor: perform loss of power testing
4. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested

1. Heat exchangers
2. HW supply pumps
3. Heating water piping system
4. VFD on pumps

C. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.20.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.

D. Functions / Modes Required to Be Tested, Test Methods and Seasonal Test Requirements: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

	<u>Function / Mode</u>	<u>Test Method</u> Manual, Monitoring, Either or Both	<u>Required</u> <u>Seasonal</u> <u>Test</u> <sup>1</sup>
<b>General</b>			
1.	Test each sequence in the sequence of operations, and other significant modes and sequences not mentioned; including startup, shutdown, unoccupied & manual modes and power failure. Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with.	Manual	
In addition to, or as part of (1) above, the following modes or tests are required:			
2.	Optimization, capacity modulation and bypass function.	Both	Heating
3.	HW supply pump staging, bypass valve operation, and HWT reset. VFD operation: modulation to minimum, control system PID, verification of program settings, alarms, etc.	Both	Heating
4.	Check all alarms and safeties (high and low pressure and temperature, etc.), PRV and flow switch functions	Manual	
5.	Test each possible lead pump as lead pump. Test pump lockouts.	Manual	
6.	Verify heat exchanger inlet/outlet pressures with startup report and manufacturer's recommendations	Manual	
7.	Sensor and actuator calibration checks on: HWST, HWRT, pressure sensor controlling pump speed, mixing valve and other random checks (BAS readout against hand-held calibrated instrument must be within 0.5°F for temps. or within a tolerance equal to 10% of the pressure setpoint, with a test gage)	Manual	
8.	Constancy of differential pressure (pump control parameter)	Monitoring	Heating
9.	HW plant operation on emergency power	Manual	
10.	Verify schedules and setpoints to be reasonable and appropriate		

<sup>1</sup>Design cooling season, heating season or both. "Design" means within 5° of season design or 95% of loading design. A blank cell denotes no special seasonal test is required and that test can be executed during any season, if condition simulation is appropriate.

<sup>2</sup>Seasonal test not required if seasonal conditions can be adequately simulated.

<sup>3</sup>Refer to Special Procedures

E. Special Procedures

- False load system, if necessary.

F. Required Monitoring

- All points listed below which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. Refer to the Monitoring section at paragraph 3.22.C for additional monitoring details.

Point	Time Step (min.)	Minimum Time Period of Trend
For each heat exchanger and pump:		
HWST	10	7 days
HWRT	10	7 days

OSAT-DB	10	7 days
HWS pump current or status	10	7 days
HWS pump speed, if variable	10	7 days
HWS pump flow rate, if in BAS	10	7 days
HWS pump speed controlling parameter value	10	7 days
HWS bypass valve command	10	7 days
HHW differential pressure	10	7 days
HHW differential pressure setpoint	10	7 days
HEX Steam Control Valve output	10	7 days

G. Acceptance Criteria

1. For the conditions, sequences, and modes tested, the heat exchangers, integral components and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
2. System shall maintain the supply water setpoint to within +/- 1.0°F of the setpoint deadband without excessive hunting.
3. Pumping system and controls shall maintain the current desired pressure setpoint to within an amount equal to 10% of the setpoint value of either side of the deadband without excessive hunting.

END OF REQUIREMENTS FOR HEATING HOT WATER SYSTEM TEST

3.22

3.23 TEST AND BALANCE WORK (TAB)

A. Parties Responsible to Execute Functional Test

1. TAB contractor: perform checks using test instruments.
2. Controls contractor: operate the controls to activate the equipment.
3. CxA: to witness, direct and document testing.

B. Integral Components or Related Equipment Being Tested

1. TAB air-side

C. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.20.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.

D. Purpose. The purpose of this test is to spot check the TAB work to verify that it was done in accordance with the contract documents and acceptable practice and that the TAB report is accurate.

E. The following tests and checks will be conducted. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in this Division.



<u>Test or Check</u>	<u>Test Method</u>
1. A random sample of up to 10% the TAB report data shall be selected for verification (air velocity, air or water flow rate, pressure differential, electrical measurement, etc.). The original TAB contractor will execute the checks, witnessed by the commissioning authority. The TAB contractor will use the same test instruments as used in the original TAB work.  A failure <sup>1</sup> of more than 10% of the selected items of a given system <sup>2</sup> shall result in the failure of acceptance of the system TAB report and the TAB contractor shall be responsible to rebalance the system in its entirety, provide a new system TAB report and repeat random verifications of the new TAB report.	Demonstration
2. Verify that final settings of all valves, dampers and other adjustment devices have been permanently marked by the TAB Contractor.	Demonstration
3. Verify that the air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity. This shall include a review of TAB methods, control setpoints established by TAB and a physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all TUs taking off downstream of the static pressure sensor, the TU on the critical leg has its damper 90% or more open.	Demonstration

<sup>1</sup>Failure of an item is defined as follows:

For air flow of supply and return: a deviation of more than 10% of instrument reading

For minimum outside air flow: 20% of instrument reading

For temperatures: a deviation of more than 1°F

For air and water pressures: a deviation of more than 10% of full scale of test instrument reading

<sup>2</sup>Examples of a “system” are: the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system. Systems can be defined as smaller parts if inaccuracies in TAB work within the smaller defined system will have little or no impact on connected systems.

F. Special Procedures or Conditions

1. Rechecking shall be limited to either 10% of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

G. Required Monitoring

1. None

H. Acceptance Criteria

1. Provided in footnote to test table above.

END OF REQUIREMENTS FOR TAB TEST

END OF SECTION 230800

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## **PART 1 GENERAL**

### **1.01 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. 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.
- D. 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.

### **1.02 RELATED SECTIONS**

- A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

### **1.03 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

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- sequences.
4. NFPA Compliance: Comply with NFPA 70 "National Electric Code."

#### 1.04 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. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.
- D. Label each control device with setting or adjustable range of control.
- E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- F. Provide details of faces on control panels, including controls, instruments, and labeling.
- G. Include written description of sequence of operation.
- H. Provide wiring diagrams of contractor provided interface and I/O panels.
- I. Provide field routing of proposed network bus diagram listing all devices on bus.

### PART 2 PRODUCTS

#### 2.01 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.

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- 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. Steam and Hot Water
    - a) Manufacturer: Do not allow KMC valves and actuators.
    - b) Water Service Valves: Equal percentage characteristics.
    - c) Steam Service Valves: Equal percentage characteristics.
    - d) Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
    - e) Valve Trim and Stems: Polished stainless steel.
    - f) Packing: Spring-loaded Teflon, self-adjusting.
    - g) Control valves should have a minimum 100 psi close-off rating for chilled water applications.
  2. Hydronic Chilled Water and Heating Water
    - a) Hydronic control valves shall be pressure independent. 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 1/2-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. Control Dampers: Ruskin CD-50 or approved equal.
1. Provide dampers with parallel blades for 2- position control.
  2. Provide opposed blades for modulating control.
  3. Dampers shall be low leakage design with blade and edge seals.
  4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.
- E. 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

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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.

F. 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.

G. 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.
  - 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

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- 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 thread-o-let.
  - (5) Thermowell Insertion depth shall be 1/2 the inside pipe diameter but not to exceed 10".
- f) Assembly:
- (1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.
  - (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
- H. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.
- I. 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.
- J. Humidistats: Humidistats must be contamination resistant, capable of ±2% RH accuracy, have field adjustable calibration and provide a linear proportional signal.
- 1. HD20K-T91 or equivalent.
- K. Humidity High Limit
- 1. Multi-function device that can function as a high limit or proportional override humidity

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controller, as stand-alone proportional controller, or a stand-alone two-position controller.

a) Johnson Controls TRUERH HL-67N5-8N00P or approved equal.

- L. Carbon Dioxide Sensor:
1. Wall Mount: ACI Model ESENSE-R.
  2. Duct Mount: ACI Model ESENSE-D.
- M. Fan/Pump Status: Status points for fan or pump motors with a VFD must be connected to the terminal strip of the VFD for status indication.  
Current switches: Current switches are required for fan and pump statuses that are not connected to a VFD. The switches must have an adjustable trip setpoint with LED indication and be capable of detecting broken belts or couplings. Units shall be powered by monitored line, UL listed and CE certified, and have a five year warranty.
1. Kele, Hawkeye or approved equal.
- N. Relays Used for Fan and Pump Start/Stop: Must have LED indication and be mounted externally of starter enclosure or VFD.
1. Kele, RIBU1C or approved equal.
- O. 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.
- P. Pressure Differential Switch:
1. Fans: NECC model DP222 or approved equal.
- Q. 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) Setra model 267, or approved equal.
    - b) Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.
- R. Building Static Pressure: Transducer shall utilize a ceramic capacitive sensing element to provide a stable linear output over the specified range of building static pressure. Transducer shall be housed in a wall-mounted enclosure with LCD display. Transducer shall have the following capabilities:
1. Input Power: 24 VAC
  2. Output: 0-10 VDC
  3. Pressure Range: -0.25 to +0.25 inches w.g.
  4. Display: 3-1/2 digit LCD, displaying pressure in inches w.g.

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5. Accuracy: +/- 1.0% combined linearity and hysteresis
  6. Temperature effect: 0.05% / deg C
  7. Zero drift (1 year): 2.0% max
  8. Zero adjust: Push-button auto-zero and digital input
  9. Operating Environment: 0 to 140 deg F, 90% RH (non-condensing)
  10. Fittings: Brass barbs, 1/8" O.D.
  11. Enclosure: High-impact ABS plastic
  12. Outside Air Sensor Pickup Port: UV stabilized thermoplastic or aluminum "can" enclosure to shield outdoor pressure sensing tube from wind effects. BAPI ZPS-ACC10-rooftop mount, wall mount, or equivalent.
  13. Transducer shall be Veris Industries Model PXPLX01S, equivalent from Setra, or approved equal.
- S. 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 1/4" compression fittings.
1. Kele model AFS-460-DDS, or approved equal.
- T. 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).



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- e) Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of  $\pm 0.15^\circ$  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.
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	4
2 to <4	6
4 to <8	8
8 to <16	12
$\geq 16$	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

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- from transients and power surges.
- 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.
- U. 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.
- V. Magnetic Flowmeter for Chilled Water, Tower Water, Make Up Water:
- 1. The Magnetic Flowmeter flow tube and computer/transducer shall come as a complete system assembled by a single manufacturer. The flowmeter shall be suitable for use in the accurate measurement of Chilled Water flow, Cooling Tower Water flow, or Make Up water flow for process control and/or utility metering, in a mechanical room environment, with a Johnson Controls EMCS system.
  - 2. The flowmeter shall consist of a pulsed DC electromagnetic coil incorporating Faraday's Law utilizing the flowing Water as the conductor. The flowmeter shall provide proper grounding for use in Schedule 40 steel pipe, Schedule 10S stainless steel pipe, or copper pipe as application requires.

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3. The flowmeter element should be sized to maintain maximum accuracy over the flow range of the application while keeping flow tube velocity below 15 fps at max flow. The flowmeter element shall be the flow tube, spool piece type with a non-conductive lining and no intrusions into the flow path. The flowmeter flow tube shall be suitable for direct mounting to standard ANSI flanges.
4. The flowmeter shall have a local LCD display that indicates flow in GPM and/or Total gallons from the totalizer. The flowmeter shall be programmable/configurable via local push buttons. The flowmeter computer/transducer shall be remote mounted. The flow tube shall have a direct mounted junction box for wiring connections.
5. The flowmeter shall have the capability to be calibrated insitu to verify proper operation and accuracies.
6. The flowmeter shall also meet the following specifications:
  - a) Measures Bi-directional flow.
  - b) Zero-point stability.
  - c) Flow tube can withstand a full vacuum on an intermittent basis.
  - d) Normal obstructions, partially opened valves, 90° or 45° elbows, and pump discharges shall require no more than 5 pipe diameters upstream and 3 pipe diameters downstream of straight pipe run for specified performance.
  - e) Auto re-start after electrodes have lost wetness.
  - f) Computer/transducers shall be interchangeable to multiple flow tubes without affecting the published accuracies of the meter.
  - g) Computer/transducer internal electronic components, including power supply and output boards, shall be field interchangeable/exchangeable.
  - h) Calibration: NIST Traceable, certificate provided with each meter.
  - i) Electrode Pressure Rating: Equivalent to flow tube flange rating
  - j) Minimum Conductivity: 5 mS/cm for fluid to be measured
  - k) Transmitter Ambient Temp.: 122 °F
  - l) Flow Tube Process Temp.: 32 °F to 140 °F for Chilled Water applications
  - m) Flow Tube Process Temp.: 32 °F to 140 °F for Make Up Water applications
  - n) Flow Tube Process Temp.: 32 °F to 311 °F for Hot or Dual Water applications
  - o) Flow Range: +/- 0 to 30 fps
  - p) Accuracy (velocity < /= 1.0 fps): +/- 0.5% of reading or +/- 0.005 fps
  - q) Accuracy (velocity > 1.0 fps): +/- 0.5% of reading
  - r) Analog Output: 4-20 mA, linear to flow in GPM
  - s) Analog Output Accuracy: +/- 0.05% of span
  - t) Repeatability: +/- 0.1%
  - u) Stability: +/- 0.1%
  - v) Ambient Temperature Effect: <1% per 100 °F
  - w) Vibration Effect: 0.1% (remote mounted transducer)
  - x) Low Flow Cutoff: settable to 0.04 fps or lower
  - y) Low Flow Cutoff Analog Output: Analog output shall be 4.0 mA at flows below the low cutoff.
  - z) Humidity Limits: 5-90% RH
  - aa) Power Supply: 115 VAC
  - bb) Power Consumption: 20 W maximum
  - cc) Enclosures: NEMA 4

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- dd) Flow Tube working pressure: 150 psi
  - ee) Flanges: Carbon steel, ANSI Class 150#
  - ff) Electrodes: Corrosion resistant Alloy C
  - gg) Cable Length: As required per plans, 150 ft minimum
  - hh) Cable shall be capable of empty pipe detection.
  - ii) All cable shall be provided by the meter manufacturer.
7. The flowmeter shall be Foxboro IMT31A with 9500A, 9700A for high temperature, or approved equal.
8. Bids/Submittals: All bids and/or submittals must include published specifications, specific model number configurations, and operation & maintenance manuals.
9. Warranty: All parts and components as needed for the specified operation and performance shall be covered under warranty for a period of not less than two years.
- W. Ultrasonic Level Transmitter for Cooling Tower Basin Water: Furnish and install, where indicated on plans, a device for measuring the tower basin water level. The level transmitter shall meet the following specifications:
- 1. Make: Flowline
  - 2. Model: EchoSpan LU83-51-01
  - 3. Range: 8" to 26.2 feet
  - 4. Accuracy: 0.2% of span in air
  - 5. Resolution: 0.039"
  - 6. Beam width: 3"
  - 7. Dead band: 8"
  - 8. Display type: 6 digit LCD
  - 9. Display units: Inch, cm, %
  - 10. Memory: Non-volatile
  - 11. Supply voltage: 12-28 VDC
  - 12. Loop resistance: 500 Ohms @ 24 VDC
  - 13. Signal output: 4-20 mA two-wire
  - 14. Signal invert: 4-20 mA or 20-4 mA
  - 15. Calibration: Push button
  - 16. Fail-safety: Selectable 4 mA, 20 mA, 21 mA, 22 mA, or hold
  - 17. Process temperature: -4 °F to 140 °F
  - 18. Temp. Comp.: Automatic
  - 19. Electronics temp.: -40 °F to 160 °F
  - 20. Pressure: 30 psi @ 25 °C, derated @ 1.667 psi/°C above 25 °C
  - 21. Enclosure rating: NEMA 4X (IP65)
  - 22. Enclosure vent: Water tight membrane
  - 23. Enclosure material: PC/ABS FR
  - 24. Trans. Material: PVDF
  - 25. Process mount: 2" NPT
  - 26. Mounting gasket: Viton
  - 27. Conduit entrance: Dual, ½" NPT
  - 28. Classification: General purpose
  - 29. CE compliance: EN 61326 EMC

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30. Level transmitter shall be Flowline EchoSpan LU83-51-01 or equivalent.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF CONTROL SYSTEMS**

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- 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

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- 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.
  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 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.

### 3.02 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. VAVs-First Pass
  - a) Power, (FC or N2 bus), and control wire installed before owner can make first commissioning pass. First pass includes installation of VAV controller, termination of power, control and network communication wiring.
5. 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.
6. VAVs-Second Pass
  - a) After the air handlers are running and under static pressure control and the heating water system is operating, a second pass can be made on the VAVs to download the control program and commission controllers to verify the VAV dampers, thermostat, and reheat control valves are working properly.
7. Exhaust and Energy Recovery Systems
  - a) Exhaust fans need to be operational and under control before labs can be commissioned.
8. Lab Air Controls
  - a) Lab Air Controls vendor will have the same requirements as stated above for VAVs.
9. Some balance work can be done alongside the control work as long as areas are mostly complete and all diffusers are in place.

### 3.03 CLOSEOUT PROCEDURES

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- 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**



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**SECTION 23 09 93 - SEQUENCE OF OPERATION**

**1. GENERAL**

- 1.1 The sequences provided in this section are subject to minor modifications during shop drawing review phase and system start-up. These minor changes are usually due to the specific operating characteristics of the HVAC equipment actually installed and/or building dynamics. These minor sequence modifications shall be incorporated without additional charges to the Owner.
- 1.2 All control set points called out shall be adjustable through software.
- 1.3 Refer to drawings for sequences of operation.

END OF SECTION 23 09 93

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## **SECTION 23 21 13 - HYDRONIC PIPING**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

A. Above grade pipe, fittings, and joints for:

1. Heating water piping system.
2. Equipment drains and overflows.

B. Valves.

#### **1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

A. Quality assurance.

B. References.

C. Submittals.

D. Operation and maintenance manuals.

E. Project record documents.

1. Record actual locations of valves.

F. Delivery, storage, and handling.

#### **1.3 SYSTEM DESCRIPTION**

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

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- C. Where connecting ferrous and non-ferrous piping materials, use full-port ball valves with bronze construction or a galvanized steel dielectric nipples with plastic liner to separate piping materials.
- D. Use gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers or as shown on plans.
- E. Use ball or butterfly valves for throttling, bypass, or manual flow control services or as shown on plans.
- F. Use lug end butterfly valves to isolate equipment.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to International Mechanical Code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state and local labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

#### 1.6 EXTRA MATERIALS

- A. Provide two repacking kits for each size and valve type.

### 2. PRODUCTS

#### 2.1 STEEL PIPING, FITTINGS, AND JOINTS

- A. Applicable Systems
  - 1. Heating water
- B. Pipe: ASTM A53, Schedule 40, Grade B, black steel.
- C. Fittings (2" and smaller): Malleable Iron: ASTM B16.3, Class 150, threaded or Cast Iron: ASTM B16.4, Class 125, threaded.

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- D. Fittings (2-1/2" and larger): ASTM B16.9, steel butt weld fittings.
- E. Joints (2" and smaller): Threaded.
- F. Joints (2-1/2" and larger): AWS D1.1, welded.
- G. Branch Tees: Weld-O-Lets and Thread-O-Lets are acceptable for branch piping when main piping is 1" or larger than branch piping.
- H. Saddle Tees: Are acceptable for branch piping when main piping is 2" or larger than branch piping.
- I. Unions (2" and smaller): 150 psig malleable iron, threaded.
- J. Flanges (2-1/2" and larger): 150 psig forged steel, slip-on, 1/16 inch thick preformed neoprene gaskets.

## 2.2 COPPER TUBING, FITTINGS, AND JOINTS

- A. Applicable Systems
  - 1. Heating water
  - 2. Chilled water
  - 3. Equipment drains and overflows
- B. Pipe: ASTM B88, Type L, hard drawn
- C. Copper Tubing: ASTM B88, Type DWV, hard drawn piping on equipment drains and overflows ONLY.
- D. Fittings and Unions (2" and smaller): ASME B16.22 wrought copper and bronze:
  - 1. Solder filler metals: ASTM B32, lead-free alloys.
  - 2. Flux: ASTM B813, water-flushable.
- E. Joints:
  - 1. Joints: ASTM B32, Alloy B solder, for piping 1-1/2" and smaller. AWS A5.8, BCuP silver braze, for piping 2" and larger.
- F. Flanges (2-1/2" and larger): Bronze, 1/16 inch thick preformed neoprene gaskets.

## 2.3 DIELECTRIC NIPPLE

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- A. Electroplated steel nipple, complying with ASTM F 1545 and IAPMO PS 66.
  - 1. Rated for 300 psig at 225 deg F.
  - 2. Male threaded or grooved end connections.
  - 3. Inert and noncorrosive propylene lining.

2.4 VALVES

A. CALIBRATED BALANCE VALVES

- 1. Pre-Set Balance Feature. Valves to be designed to allow Installing Contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with scheduled flow rates.
- 2. Valve Design and Construction. All valves shall have a calibrated orifice or venturi section, two ¼" threaded pressure tap ports with integral seals, and memory stop to retain the set position. Valves should be rated for 125 psig working pressure and 250 Deg. F maximum operating temperature.
- 3. Valves shall be selected based on flowrate, not on pipe size dimensions.
- 4. Preformed Insulation. All valves to be provided with molded insulation to permit access for balance and read-out.

B. GATE VALVES

- 1. Up To and Including 2 Inches:
  - a. Bronze body, bronze trim, union bonnet, rising stem, lockshield stem handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder or threaded ends, Class 125, MSS SP-80. Add valve stem extensions to all valves that will be installed in insulated piping systems.
- 2. Over 2 Inches:
  - a. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends, Class 125, MSS SP-70. Add valve stem extensions to all valves that will be installed in insulated piping systems.
  - b. Chainwheel: On valves 6" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

C. BALL VALVES

- 1. Up To and Including 2 Inches:

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- a. Bronze two piece body, stainless steel full-port ball on all systems, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends. Include stem extensions on valves used in insulated piping systems.

**D. BUTTERFLY VALVES**

1. 2-1/2 Inches and Larger:

- a. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
- b. Disc: Aluminum bronze on closed systems and stainless steel on open systems.
- c. Stem: Stainless steel, extended on insulated systems as required to allow valve operation without damage to the insulation.
- d. Operator (4" and smaller): 10 position lever handle with memory stop, gear drive.
- e. Operator (6" and larger): Handwheel, gear drive.
- f. Chainwheel: On valves 6" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

**E. SWING CHECK VALVES**

1. Up To and Including 2 Inches:

- a. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

2. Over 2 Inches:

- a. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

**F. SPRING LOADED CHECK VALVES**

1. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

**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. Prepare piping connections to equipment with flanges or unions.



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- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.2 INSTALLATION

- A. Where connecting ferrous and non-ferrous piping materials, use full-port ball valves with bronze construction or a galvanized steel dielectric nipples with plastic liner to separate piping materials.
- B. Heating water connections to terminal units shall be copper (no steel).
- C. Install all piping in accordance with ASME B31.9.
- D. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- E. Install piping to conserve building space, and not interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Sleeve pipe passing through partitions, walls and floors.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- J. Refer to Section 23 05 29 and Section 23 05 48 for installation of supports and hangers.
- K. Provide insulation clearance and access to valves and fittings in hangers and from structure and other equipment. Insulation shall be continuous through all hangers and supports. Refer to Section 23 07 19.**
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor and requirements of Section 23 05 00.
- M. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- N. Install unions on both sides of each control valve and on one side of all other valves. Install unions on the equipment side of final connections to each piece of equipment. Unions are not required at flanged valves or equipment.

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- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- P. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Provide insulated valve stem extensions on all valves installed in insulated piping systems.
- S. Install chainwheel operators on valves 6" and larger that are installed 8-feet above finished floor or greater. Extend chain down to maximum 5-feet above finished floor.
- T. Where possible, pipe connections shall be installed with the branch piping connected to the top of the main/header. If this is not possible due to space constraints, a connection with the same vertical centerline is acceptable. Connections to the bottom of the main/header is not allowed.
- U. Provide solid chrome plated steel escutcheons cover the sleeves and openings at walls and ceilings in exposed areas.

### 3.3 SYSTEM FLUSHING, FILLING, PRESSURE TESTING AND CLEANING

- A. Flush, fill, pressure test and clean all new hydronic systems and parts of existing systems which have been altered, extended or repaired.
- B. Flush and fill systems with all valves open to coils. Bleed air from coils and piping. Clean strainers. Refer to Section 23 25 00.
- C. Pressure Test Procedure:
  - 1. Reference Section 23 05 00 for minimum test pressures.
  - 2. Submit copy of Pipe Pressure Test Log provided in section 23 05 00 for each section of piping tested. Refer to 23 05 00 for general pipe pressure testing requirements (i.e., test pressure gages, inspections, etc.).
  - 3. Leave joints including welds uninsulated and exposed for examination during the test.
  - 4. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
  - 5. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
  - 6. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

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7. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test.
8. After the hydrostatic test pressure has been applied for at least 12 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

D. Clean systems.

1. System Cleaner:
  - a. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - b. Biocide.
2. Closed System Treatment (Water):
  - a. Sequestering agent to reduce deposits and adjust pH.
  - b. Corrosion inhibitors.
  - c. Conductivity enhancers.
3. Preparation
  - a. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
  - b. Place terminal control valves in open position during cleaning.
  - c. Verify that electric power is available and of the correct characteristics.
4. Cleaning sequence
  - a. For the purposes of this specification, “clean water” shall be defined as water with the following properties:
    - 1) Iron < 5 ppm
    - 2) Copper < 5 ppm
    - 3) Zinc < 5 ppm
    - 4) Magnesium < 1 ppm
    - 5) Calcium < 1 ppm
    - 6) Silica < 25 ppm
    - 7) Nitrate < 25 ppm
    - 8) Molybdenum < 25 ppm
    - 9) Lead < 5 ppm
    - 10) Arsenic < 5 ppm
    - 11) Chloride < 25 ppm

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- 12) Sulfate < 25 ppm
- 13) Acidity < 1000 ppm
- 14) Phosphate, 2250-3750 ppm
- 15) Boron > 150 ppm
- 16) PH acceptable range: 8.0 to 9.5
- 17) Tolyltriazole > 150 ppm
- 18) Reserve Alkalinity 3.0 to 6.0 mils/lite
- 19) Sediments = none

b. Concentration:

- 1) As recommended by manufacturer.
- 2) One pound per 100 gallons of water contained in the system.
- 3) One pound per 100 gallons of water for hot systems and one pound per 50 gallons of water for cold systems.
- 4) Cleaning chemicals for use in hydronic systems shall be specifically designed for hydronic systems and compatible with pipes, fittings, coils, valves, equipment, etc.

c. Hot Water Heating Systems:

- 1) Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
- 2) Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.
- 3) Circulate for 6 hours at design temperatures, then drain.
- 4) Refill with clean water and repeat until system cleaner is removed.

d. Chilled Water Systems:

- 1) Circulate for 48 hours, then drain systems as quickly as possible.
- 2) Refill with clean water, circulate for 24 hours, then drain.
- 3) Refill with clean water and repeat until system cleaner is removed.

END OF SECTION 23 21 13

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## **SECTION 23 21 16 - HYDRONIC SPECIALTIES**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Air vents.
- B. Strainers.
- C. Flexible connections.

#### **1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. References.
- B. Submittals.
- C. Project record documents
  - 1. Record actual locations of hydronic specialties.

#### **D. OPERATION AND MAINTENANCE DATA**

- 1. Furnish service and maintenance of glycol system for one year from date of substantial completion.
- 2. Monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.
- 3. Provide full laboratory analysis of fluid at 6 months and 12 months from the date of substantial completion.

#### **E. QUALIFICATIONS**

#### **F. DELIVERY, STORAGE AND HANDLING**

### **2. PRODUCTS**

#### **2.1 AIR VENTS**

- A. Manual Type: Short vertical sections of equal diameter pipe, up to 2", to form air chamber, with ball valve, hose connection, and cap.

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## 2.2 STRAINERS

### A. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch Type 304 stainless steel perforated screen.

### B. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch Type 304 stainless steel perforated screen.

### C. Size 5 inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch Type 304 stainless steel perforated screen.

### D. Provide blowdown valves where shown on plan.

## 2.3 FLEXIBLE CONNECTIONS

### A. Spherical, Rubber, Flexible Connectors:

1. Body: Peroxide-cured EPDM synthetic rubber and Kelvar tire cord reinforcement.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Control Rods: Steel with oversized washers and rubber bushings.
4. Performance: Capable of misalignment.
5. CWP Rating: 150 psig.
6. Maximum Operating Temperature: 250 deg F.
7. Manufacturer: Mason Industries model Safeflex or equivalent.

### B. Stainless steel braided connection with steel flange rated for 225 psig and 16" Hg vacuum. Operating temperature 20 degrees F. to 240 degrees F.

### C. Minimum allowable movement shall be as follows:

Lateral Deflection	1/2"
Elongation	3/8"
Compression	1/2"
Angular Deflection	15 degrees

## 3. EXECUTION

### 3.1 INSTALLATION

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- A. Install specialties in accordance with manufacturer's instructions and as shown on drawings.
- B. Provide manual air vents at all system high points and in accessible locations.
- C. Provide drain valves at all low points and in accessible locations.
- D. Provide valved drain and hose connection on strainer blow down connection.
- E. Provide flexible connectors on all pipe connections that serve vibration isolated mechanical equipment.
- F. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- G. Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.
- H. Feed glycol solution to system through glycol feeder make-up line with pressure regulator, venting system high points.
- I. Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION 23 21 16



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## **SECTION 23 22 13 - STEAM AND CONDENSATE PIPING**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Pipe and pipe fittings for:
  - 1. Steam, condensate, and blowdown piping.
- B. Valves

#### **1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. References.
- B. Submittals.
- C. Project record documents.
  - 1. Record actual locations of valves.
- D. Operation and maintenance data.
- E. Qualifications.
- F. Delivery, storage and handling.

#### **1.3 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- C. Use non-conducting dielectric connections whenever jointing dissimilar metals.

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- D. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.
- E. Use gate or ball valves as shown on plans.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state and local labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

## 2. PRODUCTS

### 2.1 STEAM PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Type S seamless, Grade B, Schedule 40, black.
  - 1. Fittings: ASTM B16.3, Class 150, Schedule 40, cast iron, threaded (2" and smaller); ASTM A234, ANSI B16.9, butt welding carbon steel fittings, Schedule 40, standard weight (2-1/2" and larger). All elbows shall be long radius type unless otherwise noted.
  - 2. Joints: Threaded (2" and smaller), or AWS D1.1, welded (2-1/2" and larger).
  - 3. Branch Tees: Weld-O-Lets and Thread-O-Lets are acceptable for branch piping when main piping is 1" or larger than branch piping.
- B. High/Medium Pressure Steam Drip Legs: ASTM A53, Type S seamless, Grade B, Schedule 80, black.
  - 1. Fittings: ASTM B16.3, Class 150, Schedule 80, cast iron, threaded (2" and smaller); ASTM A234, ANSI B16.9, butt welding carbon steel fittings, Schedule 80, extra heavy weight (2-1/2" and larger). All elbows shall be long radius type unless otherwise noted.
  - 2. Joints: Threaded (2" and smaller), or AWS D1.1, welded (2-1/2" and larger).

### 2.2 STEAM CONDENSATE PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Type S seamless, Grade B, Schedule 80, black.
  - 1. Fittings: ASTM B16.3, Class 150, Schedule 80, malleable iron, threaded (2" and smaller); ASTM A234, ANSI B16.9, butt welding carbon steel fittings, Schedule 80, extra heavy weight (2-1/2" and larger). All elbows shall be long radius type unless otherwise noted.
  - 2. Joints: Threaded (2" and smaller), or AWS D1.1, welded (2-1/2" and larger).

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3. Branch Tees: Weld-O-Lets and Thread-O-Lets are acceptable for branch piping when main piping is 1" or larger than branch piping.

## 2.3 BLOWDOWN PIPING

- A. Steel Pipe: ASTM A53, Type S seamless, Grade B, Schedule 40, black.

1. Fittings: ASTM B16.3, Class 150, Schedule 80, malleable iron, threaded (2" and smaller); ASTM A234, ANSI B16.9, butt welding carbon steel fittings, Schedule 80, extra heavy weight (2-1/2" and larger). All elbows shall be long radius type unless otherwise noted.
2. Joints: Threaded (2" and smaller), or AWS D1.1, welded (2-1/2" and larger).
3. Branch Tees: Weld-O-Lets and Thread-O-Lets are acceptable for branch piping when main piping is 1" or larger than branch piping.

## 2.4 UNIONS, FLANGES, AND COUPLINGS

- A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.

- B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.

- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

## 2.5 BALL VALVES (ALL SERVICES)

- A. Up To and Including 1-1/2 Inches:

1. Carbon steel three piece body, 150 psi saturated steam, pressure-balanced stainless steel full port ball, stainless steel trim and hardware, teflon seats and packing, lever handle with locking stops, socket weld ends, Apollo 83A-240 or equivalent. Add valve stem extensions to all valves that will be installed in insulated piping systems.

## 2.6 GATE VALVES (LOW PRESSURE STEAM, LOW PRESSURE STEAM CONDENSATE)

- A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, union bonnet, rising stem, lockshield stem handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder or threaded ends, union on one end, Class 150. Add valve stem extensions to all valves that will be installed in insulated piping systems.

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B. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, outside stem and yoke, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends, Class 150.
2. Chainwheel: On valves 4" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve. Add valve stem extensions to all valves that will be installed in insulated piping systems.

2.7 GATE VALVES (HIGH/MEDIUM PRESSURE STEAM, HIGH/MEDIUM PRESSURE STEAM CONDENSATE)

A. Up To and Including 2 Inches:

1. Forged steel body, half stellite trim, bolted bonnet, ASTM A193 Grade B7 alloy steel stud bolts with ASTM A194 Grade 2H heavy hex nuts, handwheel, outside screw and yoke, threaded ends, Class 150. Gasket shall be stainless alloy spiral wound gasket, Class 150, 0.175" thick, Flexitallic CG, 304 SS/"Flexite Super". Add valve stem extensions to all valves that will be installed in insulated piping systems.

B. Over 2 Inches:

1. Cast steel body, half stellite trim, bolted bonnet, ASTM A193 Grade B7 alloy steel stud bolts with ASTM A194 Grade 2H heavy hex nuts, handwheel, outside screw and yoke, flanged ends, Class 150. Gasket shall be stainless alloy spiral wound gasket, Class 150, 0.175" thick, Flexitallic CG, 304 SS/"Flexite Super". Add valve stem extensions to all valves that will be installed in insulated piping systems.
2. Chainwheel: On valves 4" and larger and installed higher than 8-feet above finished floor, provide sprocket rim, brackets, and chain compatible with valve.

2.8 GLOBE VALVES

A. 2" and Smaller: Bronze Globe Valves, Class 150

1. Standard: MSS SP-80, Type 2.
2. CWP Rating: 300 psig.
3. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze, extended past insulation.
6. Disc: Bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron or bronze.

B. 2-1/2" and Larger: Iron Globe Valves, Class 250:

1. Standard: MSS SP-85, Type I.

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2. CWP Rating: 500 psig.
3. Body Material: ASTM A 126, gray iron with bolted bonnet.
4. Ends: Flanged.
5. Stem: Extended past insulation.
6. Trim: Bronze.
7. Packing and Gasket: Asbestos free.
8. Operator: Handwheel or chainwheel.

## 2.9 SWING CHECK VALVES

### A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

### B. Over 2 Inches:

1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

## 2.10 SPRING LOADED CHECK VALVES

- ### A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

## 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. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install steam and condensate piping in accordance with ASME B31.9.

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- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Refer to Section 23 05 29 and Section 23 05 48 for installation of supports and hangers.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- I. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- J. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- K. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- L. Install unions on both sides of each control valve and on one side of all other valves. Install unions at final connections to each piece of equipment. Unions are not required at flanged valves or equipment.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Install chainwheel operators on valves 4" and larger that are installed 8-feet above finished floor or greater. Extend chain down to maximum 5-feet above finished floor.
- O. Drip legs shall be the same size as the line to which they are connecting (for pipe sizes 4" and under). For pipe sizes 6" and greater, drip legs shall be ½ the size of the line to which they are connecting, but no less than 4".
- P. Steam pipe connections shall be made to the top of the supply pipe to which they are connecting. Use 45-degree elbows in lieu of 90-degree elbows where possible. Install shutoff valve at connection to main.
- Q. Flush, fill, pressure test and clean all new steam systems and parts of existing systems which have been altered, extended or repaired. Cleaning procedure shall include the use of a degreasing agent.

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1. Isolate all system components that are open to the surrounding air, including but not limited to steam humidifiers.
  2. Fill system, circulate as possible, then drain system.
  3. Refill with clean water and repeat until system cleaner is removed.
- R. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.
- S. Remove, clean, and replace strainer screens.
- T. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

END OF SECTION 23 22 13



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## **SECTION 23 22 14 - STEAM AND CONDENSATE SPECIALITIES**

### **1. GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Steam traps.
- B. Pressure reducing valves.
- C. Strainers.
- D. Thermostatic air vents and vacuum breakers.
- E. Flexible connections.

#### **1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. References.
  - 1. ASME Boiler and Pressure Vessel Codes, SEC 8 D Rules for Construction of Pressure Vessels.
  - 2. ASME B31.9 Building Services Piping.
  - 3. ASTM A105 Forgings, Carbon Steel, for Piping Components.
  - 4. ASTM A126 Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 5. ASTM A216 Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
  - 6. ASTM A395 Ferric Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures.
- B. Submittals.
  - 1. Product Data:
    - a. Provide for manufactured products and assemblies required for this project.
    - b. Include product description, model, dimensions, component sizes, rough in requirements, service sizes, and finishes.
    - c. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
    - d. Manufacturer's Installation Instructions: Indicate application, selection, and hookup configuration. Include pipe and accessory elevations.
- C. Operation and maintenance data.

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1. Operation and Maintenance Data: Include installation instructions, servicing requirements, and recommended spare parts lists.

D. Quality assurance.

E. Qualifications.

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

F. Regulatory requirements.

G. Delivery, storage, and handling.

## 2. PRODUCTS

### 2.1 STEAM TRAPS

#### A. INVERTED BUCKET TRAPS

1. Construction: ASTM A-278 class 30, cast iron body with bolted cover, stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.
2. Rating: 150 psig
3. Features: Access to internal parts without disturbing piping, top test plug, bottom drain plugs.
4. At contractor's option, trap valve station may be installed in lieu of using individual trap assembly components shown on drawings. Trap valve station shall be Armstrong TVS-812 or equivalent, with cast iron body, stainless steel internals, ductile iron handwheel isolation valves, stainless steel blowdown valve, stainless steel internal check valve, integral strainer, inverted bucket trap mechanism, rated for 250 psig at 450 Deg. F.

#### B. FLOAT AND THERMOSTATIC TRAPS

1. Construction: ASTM A-278 class 30, cast iron body with bolted cover, balanced pressure thermostatic air vent, stainless steel float, stainless steel lever and valve assembly.
2. Features: Access to internal parts without disturbing piping, bottom drain plugs.

### 2.2 PRESSURE REDUCING VALVES

#### A. Cast Iron Pilot Actuated Diaphragm

1. ASME labeled.
2. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.

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3. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.
4. Body: Cast iron.
5. End Connections: Threaded connections for valves 2" and smaller and flanged connections for valves 2-1/2" and larger.
6. Trim: Hardened stainless steel.
7. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.
8. Gaskets: Non-asbestos materials.
9. If Project has more than one type or size of pressure-reducing valve, delete "Capacities and Characteristics" Paragraph below and schedule pressure-reducing valve performance on Drawings.
10. Refer to Mechanical Equipment Schedule for performance and operating information.

B. Direct-Acting Compact

1. Body: Cast Bronze, ASTM B584.
2. Valve/Seat: Stainless Steel AISI 440/304.
3. Bellows: Phosphor Bronze ASTM B103.
4. End Connections: Threaded.
5. Pressure Class: 250.
6. Turndown ratio of 10:1 with ANSI Class IV shutoff.
7. Provide Armstrong GD-30 valve or equivalent.

2.3 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers 2" and smaller; flanged ends for strainers 2-1/2" and larger.
3. Strainer Screen: Stainless-steel, mesh strainer, or perforated stainless-steel basket.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

2.4 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Body: Cast iron, bronze, or stainless steel.
2. End Connections: Threaded.
3. Float, Valve, and Seat: Stainless steel.
4. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
5. Pressure Rating: 125 psig / 300 psig.
6. Maximum Temperature Rating: 350 deg F.

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**B. Vacuum Breakers:**

1. Body: Cast iron, bronze, or stainless steel.
2. End Connections: Threaded.
3. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
4. O-Ring Seal: EPR.
5. Pressure Rating: 125 psig / 300 psig.
6. Maximum Temperature Rating: 350 deg F.

**2.5 FLEXIBLE CONNECTORS**

**A. Stainless-Steel Bellows, Flexible Connectors:**

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

**3. EXECUTION**

**3.1 INSTALLATION**

- A.** Install specialties in accordance with manufacturer's instructions.
- B.** Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- C. Condensate Pumps:**
1. Install pumps according to HI 1.1-1.2, HI 1.3, and HI 1.4.
  2. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
  3. Support pumps and piping separately so piping is not supported by pumps.
  4. Install thermometers and pressure gages.
  5. Equipment Mounting:
    - a. Install pumps on cast-in-place concrete equipment base(s).
    - b. Comply with requirements for vibration isolation devices specified in Section 23 05 48 "HVAC Vibration Controls."

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6. Install with pipe accessories as shown on the Steam and Condensate System Piping Schematic. Provide drain from condensate receiver/inlet pipe to allow condensate by-pass condensate receiver and drain to a floor drain when condensate pumps are being repaired. Install temperature sensor well in flooded portion of condensate receiver and connect to EMCS.
7. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.

D. Steam Traps:

1. Install as shown on the Steam and Condensate System Piping Schematic.
2. Install in accessible locations as close as possible to connected equipment.

E. Terminate relief valves to outdoors 30 inches minimum above roof. Provide drip pan elbow with drain connection to nearest floor drain.

F. Pressure Reducing Valves:

1. Install as shown on the Steam and Condensate System Piping Schematic.
2. Install pressure-reducing valves in accessible location for maintenance and inspection.
3. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
4. Install gate valves on both sides of pressure-reducing valves.
5. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections, respectively.
6. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Section 23 05 19 "Meters and Gages for HVAC Piping."
7. Install strainers upstream for pressure-reducing valve.
8. Install safety valve downstream from pressure-reducing valve station.
- 9.

### 3.2 STARTUP SERVICE

A. Condensate Pumps:

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Clean strainers.
3. Set steam condensate pump controls.
4. Set pump controls for automatic start, stop, and alarm operation.
5. Perform the following preventive maintenance operations and checks before starting:
  - a. Set float switches to operate at proper levels.
  - b. Set throttling valves on pump discharge for specified flow.
  - c. Check motors for proper rotation.
  - d. Test pump controls and demonstrate compliance with requirements.

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- e. Replace damaged or malfunctioning pump controls and equipment.
  - f. Verify that pump controls are correct for required application.
6. Start steam condensate pumps according to manufacturer's written startup instructions.

END OF SECTION 23 22 14

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## SECTION 23 31 13 - DUCTWORK

### 1. GENERAL

#### 1.1 SECTION INCLUDES

- A. Metal ductwork.
  - 1. Sheet metal materials.
  - 2. Sealant and gaskets.
  - 3. Fasteners.
  - 4. Seismic-restraint devices.
  - 5. Duct cleaning.
  - 6. Duct pressure testing.

#### 1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

- A. Quality assurance.
  - 1. Perform Work in accordance with the following standards:
    - a. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
    - b. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
    - c. SMACNA - HVAC Air Duct Leakage Test Manual.
    - d. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.
    - e. SMACNA - Round Industrial Duct Construction Standards
    - f. International Mechanical Code, current edition.
- B. References.
- C. Submittals.
  - 1. Submit detailed CAD-generated ductwork detail drawings at minimum 1/4" scale, with details of the following:
    - a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
    - b. Duct layout indicating pressure classification and sizes on plans.
    - c. Seam and joint construction.
    - d. Penetrations through fire-rated and other partitions.
    - e. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

**NOTE:** No installation of ductwork shall be allowed until detailed shop drawings have been reviewed by the Engineer. Any ductwork that is installed prior to the Engineer's



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review of the shop drawings shall be subject to removal and replacement at the Contractor's expense.

D. Performance requirements.

1. No variation of duct configuration or sizes shall be permitted except by written permission.
2. Structural Performance: Duct hangers, supports, and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." Reference Structural Design Criteria on General Structural Note Sheet in Structural Drawings for seismic hazard level classification.
  - a. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
  - b. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
  - c. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

E. Project record documents.

1. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.
2. Provide copy of owner approval/acceptance of ductwork cleaning.
3. Provide copy of completed duct leakage test reports.

F. Qualifications.

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
2. Installer: Company specializing in performing the work of this section with minimum five years experience.

G. Regulatory requirements.

1. Construct all ductwork per codes listed in section 1.2.E

H. Environmental requirements.

1. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
2. Maintain temperatures during and after installation of duct sealants.

**2. PRODUCTS**

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## 2.1 METAL DUCTWORK

### A. SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - a. Reference SMACNA figure 2-9 and Drawings to construct gradual transitions where ductwork changes size or offsets.
  - b. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
2. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - a. Transverse Duct Connection System
    - 1) Slide on flange system: Ductmate and Ductmate WDCI connection system complete with interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Gasket material shall be chemical resistant material in all fume exhaust ductwork.
    - 2) Formed on flange system: TDC, TDF or equivalent connection system or equivalent. Such flanges shall be constructed as SMACNA T-24 flange (Page 1-25 and 1-37 '85 SMACNA Duct Construction Manual, 1985 Edition).
3. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
4. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - a. Construct T's, and elbows in using radius of not less than 1-1/2 times width of duct on centerline. Where mitered rectangular elbows are used or indicated, provide turning vanes in accordance with Section 23 33 00.

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5. Welded ductwork is to be weld with filler rod of the same material as the metal that is being welded. Coat welded joints with protective paint to prevent damage to galvanized surfaces.

B. SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - a. Round and oval duct shall be spiral lockseam duct with light reinforcing corrugations unless indicated otherwise.
2. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
3. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  - b. Joints shall be minimum 2 inch insertion length for joint connections.
  - c. Transverse Duct Connection System
    - 1) Slip type connector: Keating coupler.
    - 2) Slide on flange system. Spiralmate and Ovalmate connection system complete with interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Gasket material shall be chemical resistant material in all fume exhaust ductwork.
    - 3) Formed on flange system: Factory-applied Van Stone connection on one end of the duct with field-applied Van Stone connector on the other end of the duct. Provide factory-applied Van Stone connections on each end of fittings.
4. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

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5. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - a. Construct T's, bends, and elbows with minimum bend radius elbows shall be 1.5 times the duct diameter (major or minor axis on oval ductwork depending on direction of bend). Where not possible and where mitered elbows are used or indicated, provide turning vanes in accordance with Section 23 33 00.
6. Welded ductwork is to be weld with filler rod of the same material as the metal that is being welded. Coat welded joints with protective paint to prevent damage to galvanized surfaces.
7. On round and oval ducts, provide 45 deg wye tee take-offs or 90 deg conical tee take-offs or 45 degree low loss entry tee take-offs or other fitting as indicated on plans. Straight taps are not acceptable.

C. SHEET METAL MATERIALS

1. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
2. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90. Provide mill-phosphatized finish for surfaces of ducts exposed to view.
3. Stainless Steel Ducts: ASTM A 480/A 480M, Type 316 sheet form with No. 4 finish for surfaces of ducts exposed to view, and Type 304 sheet form with No. 1 finish for concealed ducts.
4. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - a. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
5. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

D. SEALANT AND GASKETS

1. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
2. Two-Part Tape Sealing System:

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- a. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - b. Tape Width: Min. 3 inches.
  - c. Sealant: Modified styrene acrylic.
  - d. Water resistant.
  - e. Mold and mildew resistant.
  - f. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - g. Service: Indoor and outdoor.
  - h. Service Temperature: Minus 40 to plus 200 deg F.
  - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - j. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Water-Based Joint and Seam Sealant:
- a. Application Method: Brush on.
  - b. Solids Content: Minimum 65 percent.
  - c. Shore A Hardness: Minimum 20.
  - d. Water resistant.
  - e. Mold and mildew resistant.
  - f. VOC: Maximum 75 g/L (less water).
  - g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - h. Service: Indoor or outdoor.
  - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
4. Flanged Joint Sealant: Comply with ASTM C 920.
- a. General: Single-component, acid-curing, silicone, elastomeric.
  - b. Type: S.
  - c. Grade: NS.
  - d. Class: 25.
  - e. Use: O.
  - f. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
6. Round Duct Joint O-Ring Seals:
- a. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

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- b. Retain one or both subparagraphs below. These are proprietary seals provided on factory-fabricated, round duct fitting joints and constructed with specific dimensions to ensure a proper seal.
- c. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
- d. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

E. FASTENERS

- 1. Rivets, bolts, or sheet metal screws.

**3. EXECUTION**

3.1 GENERAL

- A. Install in accordance with manufacturer's instructions; SMACNA HVAC Duct Construction Standards - Metal and Flexible, current edition and International Mechanical Code requirements.
- B. Seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, current edition.
- C. Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Duct transition from round to rectangular and vice versa shall be made with rectangular to round duct transition fitting.
- E. Provide flange-type joint at transverse joints or seal as specified. All transverse joints shall be inspected by the Owner prior to insulating ductwork.

3.2 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install round and flat-oval ducts in maximum practical lengths.
  - a. Install round in lengths not less than 12 feet, unless interrupted by fittings.
- C. Install ducts with fewest possible joints.

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- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- H. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
  - 1. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Keep openings covered until ready for continuing duct run or final connections.
- J. Construct and install each duct system for the specific duct pressure classification indicated.
- K. Install only low loss high efficiency fittings at takeoffs. Extractors not allowed.
  - 1. Air terminal take-offs from rectangular main ducts shall be lo-loss 45° take-offs.
  - 2. Diffusers and register take-offs from rectangular duct mains shall be lo-loss 45° fittings, with integral balancing damper that is provided with stand-off bracket and quadrant lock.
  - 3. Exhaust grille/register branch duct connections to rectangular mains shall be lo-loss 45° entry fittings with integral balancing damper.
- L. Install couplings tight to duct wall surface with a minimum of projections into duct.
- M. Install ducts with a clearance of 2 inch, plus allowance for insulation thickness.
- N. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke

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dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Firestopping."

1. Refer to drawings for more information.
- P. Verify location of air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to reflected ceiling plans, finish schedule, material finish specification, and shop drawings.
- Q. Coordinate routing with all other trades to establish space requirements for each.
- R. Contractor may vary route and shape of ductwork and make offsets during progress of work if required to meet structural or other interferences. Where such changes impair the system performance, the changes will be corrected at Contractor's expense.
- S. All ductwork shall be substantially and neatly supported on galvanized steel straps or angles riveted or bolted to duct flanges and properly anchored to the construction so that horizontal ducts are without sag or sway, vertical ducts are without buckle, and all ducts are free from the possibility of deformation, collapse or vibration. Support at each joint and at 4 feet on center maximum.
- T. Openings required for ductwork through structural elements in new construction shall be coordinated with the General Contractor. Shop drawings locating such openings shall be prepared in ample time to meet the construction schedule.
- U. Provide sleeves at all duct penetrations through walls, floors and roofs. Openings through sound-rated partitions shall have annular space stuffed with fiberglass insulation for full thickness of wall.
- V. Provide 2-inch deep bitumastic coated drip pans on all non-ducted hoods, fans or penthouses used for relief or exhaust air service. Pans shall be 12 inches larger all around than roof opening with clear vertical openings between pan and structure as indicated. Insulate pan where indicated.
- W. Where required on drawings, install automatic control dampers as recommended by the manufacturer.
- X. Prevent passage of unfiltered air around filters with felt, rubber, neoprene gaskets, or other approved safing material.
- Y. Provide openings in ductwork to accommodate thermometers and controllers. Provide pitot tube openings for testing of systems, complete with metal cap with spring device or screw to prevent air leakage.



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- Z. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
  - AA. Paint ductwork visible behind wall-mounted air outlets and inlets matte black.
    - 1. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.
  - BB. Change duct sizes gradually, not exceeding 30 degrees (15 degrees ideally) divergence and 45 degrees (30 degrees ideally) convergence.
  - CC. Use crimp joints with or without bead for joining round duct sizes 8 inches and smaller and install with crimp in direction of air flow.
  - DD. Provide return air grilles open to ceiling plenum with duct boot with minimum longitudinal dimension 2' X 2'.
  - EE. Provide flexible connect between ductwork and all moving equipment.
    - 1. Provide 1-inch slack for free movement.
  - FF. Join VAV boxes to medium pressure supply duct mains with minimum straight length of duct equal to 5 times box inlet diameter size. Duct to be rigid. Flexible ductwork is not allowed to join boxes to supply duct main.
  - GG. Threaded cap test holes shall be provided in all ductwork. Test holes shall be installed after the reheat coil in all VAV boxes. Provide extensions to allow for insulation thickness. Test holes shall be "Ventlok" or equal.
  - HH. No flexible duct shall be allowed on this project.**
  - II. Cover all exposed fiberglass insulation with duct tape.
- 3.3 INSTALLATION OF EXPOSED DUCTWORK
- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
  - B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
  - C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

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- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
  - E. Repair or replace damaged sections and finished work that does not comply with these requirements.
  - F. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
  - G. Provide closure flanges around exposed ductwork at wall and ceiling penetrations, 1-1/4 inches wide minimum.
- 3.4 INSTALLATION OF 2" AND GREATER PRESSURE CLASS DUCTWORK (POSITIVE OR NEGATIVE PRESSURE)
- A. All round and oval duct elbows installed shall be die-formed, gored, pleated or mitered. All mitered elbows shall be equipped with turning vanes.
  - B. On round and oval ducts, provide 45 deg wye or 90 deg conical tee take-offs as indicated on plans. Straight taps are not acceptable.
  - C. All diverging flow fittings shall be constructed such that no excess material projects from the body into the branch tap entrance.
  - D. Transverse joints of all rectangular ducts greater than 24" wide or deep shall be fabricated with flanging system as called out previously (Ductmate or equivalent).
- 3.5 INSTALLATION OF 1" AND LESS PRESSURE CLASS DUCTWORK (POSITIVE OR NEGATIVE PRESSURE)
- A. All round duct elbows installed shall be of the adjustable, die-formed, gored, pleated or mitered type. All adjustable elbows shall be sealed after installation.
  - B. All mitered elbows shall be equipped with turning vanes.
  - C. Connect ceiling diffusers to low pressure ducts with adjustable elbow at duct and short length of flexible duct held in place with strap or clamp. Do not use flexible duct to change direction.
- 3.6 CLEANING

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- A. **The air handling units, energy recovery wheel, exhaust fans, and other HVAC airside equipment shall not be used for temporary building conditioning without the written permission from the Owner and Architect/Engineer.** Open ductwork that has been installed shall be protected during the duration of the project with polyethylene plastic and duct tape over the open ends. Uninstalled ductwork shall be protected from construction dust by covering the uninstalled ductwork with polyethylene plastic. Prior to installing ductwork, the inside of the ductwork shall be wiped down or vacuumed.
- B. Clean inside all air handling units, energy recovery units, and outside air duct systems before the fans are turned on. Call for inspection by the owner’s representative to verify that all ducts are cleaned. If the ductwork is unacceptable, the contractor shall provide vacuuming of these duct systems by forcing air at high velocity through duct where manual cleaning in not possible due to duct lengths or size. Call for re-inspection by Owner’s representative.
- C. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- D. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- E. Use service openings, as required, for physical and mechanical entry and for inspection.
- F. Call for inspection by Owner's representative and provide documentation of owner approval to engineer and include copy in maintenance manuals.
- G. Install a fresh set of filters in all equipment immediately prior to project turnover.

3.7 DUCTWORK SCHEDULE

Duct System:	Material:	Longitudinal Joints:	Transverse Joints:	Pressure Class:	Sealant Class:	Leakage Class:	Additional Notes:
Outside air system upstream of AHU	Galv. Steel	3A	4A, 4C	-6"	B	24	
Round SA system upstream of terminal units	Galv. Steel	3C, 3E	4B, 4D	+10"	A	3	8B, 8D
Round SA system between terminal units and bubble tight damper	Galv. Steel	3C, 3E	4B, 4D	+10"	A	12	8B
Round SA system downstream of bubble tight damper (BSL3)	Stainless Steel	3E	4D	+6"	A	ZERO DUCT LEAKAGE	8B, 8D
Round BSL3 EA system between HFH and terminal unit	Stainless Steel	3E	4D	-10"	A	ZERO DUCT LEAKAGE	8A, 8B, 8D

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Duct System:	Material:	Longitudinal Joints:	Transverse Joints:	Pressure Class:	Sealant Class:	Leakage Class:	Additional Notes:
Round BSL3 EA system upstream of terminal unit	Stainless Steel	3E	4D	-6"	A	ZERO DUCT LEAKAGE	8A, 8B, 8D

**DUCTWORK SCHEDULE NOTES:**

Longitudinal Joint Options:

- 3A: Pittsburgh lock. Refer to Figure 1-5, SMACNA.
- 3B: Button punch snap lock. Refer to Figure 1-5, SMACNA.
- 3C: Spiral lockseam.
- 3E: Welded.
- 3F: Double-wall, pre-manufactured sheet metal plenum.
- 3G: Butt-welded, fully-welded around entire perimeter of joint from outside in accordance with IMC.

Transverse Joint Options:

- 4A: Pre-manufactured flanged duct connection system specified under “Products” section of this specification.
- 4B 0-24” Major Axis Diameter: Interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening.  
 26” Major Axis Diameter and Up: Pre-manufactured flanged duct connection system specified under “Products” section of this specification.
- 4C: Any standard transverse joint as shown in Figure 1-4 of SMACNA is acceptable.
- 4D: Welded
- 4E: Fully-welded at all joints from outside in accordance with IMC.

Sealant Class Options:

- 6: Seal class is defined by the following table (refer to Table 4-1, SMACNA HVAC Air Duct Leakage Test Manual):

Seal Class:	Sealing Required:
A	All transverse joints, longitudinal seams, and ductwork penetrations. Pressure sensitive tape shall not be used as a primary sealant on metal ducts.
B	All transverse and longitudinal seams. Pressure sensitive tape shall not be used as a primary sealant on metal ducts.
C	Transverse joints only.

Leakage:

- 7: Leakage Class is defined by Figure 4-1, SMACNA HVAC Air Duct Leakage Test Manual.

Additional Comments:

- 8A: See Drawings for further information regarding extent of stainless steel ductwork.
- 8B: Field welded ductwork is to be welded with filler rod of the same material as the metal that is being welded. Field coat welded joints with protective paint to prevent damage to galvanized surfaces.
- 8C: Ductwork to be constructed in accordance with IMC requirements for grease ducts.

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**8D: Regardless if allowable by SMACNA, Snaplock longitudinal joints shall not be used for round ductwork.**

3.8 PRESSURE TESTING

- A. Perform and complete the following field tests, inspections, and test reports according to SMACNA's "HVAC Air Duct Leakage Test Manual":
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  3. Maximum Allowable Leakage: Refer to paragraph 3.7.
  4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.
  5. Test no less than
    - a. 100% of the newly installed supply air ductwork
    - b. 100% of the newly installed exhaust air ductwork
  6. Submit completed test reports to engineer and include copy in maintenance manual.

END OF SECTION 23 31 13

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**SECTION 23 33 00 - DUCTWORK ACCESSORIES**

**1. GENERAL**

**1.1 SECTION INCLUDES**

- A. Turning vanes.
- B. Duct access doors.
- C. Duct test holes.
- D. Flexible duct connections.
- E. Manual balancing dampers.
- F. Remote damper operators.

**1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:**

- A. References.
- B. Submittals.
- C. Project record documents.
  - 1. Record actual locations of access doors, test holes etc.
- D. Qualifications.
  - 1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- E. Regulatory requirements.
  - 1. Products Requiring Electrical Connection: UL Listed and classified.
- F. Delivery, storage, and handling.
- G. Extra materials.

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1. Provide two of each size and type of fusible link for fire and combination fire/smoke dampers.

## 2. PRODUCTS

### 2.1 TURNING VANES

#### A. General:

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
2. Note that air extractors or "scoops" shall not be used under any circumstances.

#### B. Manufactured and Fabricated Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
2. Single-Thickness Vane Construction: Vanes shall be single-thickness, quarter-circle shape with 2" radius, minimum 3.15" length, and spaced 1.5" on center.
3. Double-Thickness Vane Construction: Vanes shall be double-thickness, quarter-circle shape, with 4.5" radius and spaced 3.25" on center.

### 2.2 DUCT ACCESS DOORS

#### A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Double wall, rectangular door.
2. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
3. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
  - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
  - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
  - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
  - d. Access Doors Larger Than 24 by 48 Inches : Four hinges and two compression latches with outside and inside handles.
  - e. Fabricate doors airtight and suitable for duct pressure class.
4. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

### 2.3 DUCT TEST HOLES

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- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.4 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches to 5-3/4 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.
  - 1. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
    - a. Minimum Weight: 26 oz./sq. yd.
    - b. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
    - c. Service Temperature: Minus 40 to plus 200 deg F.
  - 2. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
    - a. Minimum Weight: 24 oz./sq. yd.
    - b. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
    - c. Service Temperature: Minus 50 to plus 250 deg F.
  - 3. Fume Exhaust System, Flexible Connectors: Glass fabric with chemical-resistant coating.
    - a. Minimum Weight: 14 oz./sq. yd.
    - b. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
    - c. Service Temperature: Minus 67 to plus 500 deg F.
  - 4. Fan Discharge Flexible Connectors: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.



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- a. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
- b. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
- g. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.5 MANUAL BALANCING DAMPERS

### A. General:

1. Suitable for horizontal or vertical applications.
2. Fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
3. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
4. **Provide 304 stainless steel construction when installed in stainless steel duct systems.**

### B. Single Blade Dampers:

1. Ruskin models MD25 (rectangular), MDRS25 (round) or equivalent.
2. Fabricate for duct sizes up to 6 x 30 inch.
3. Frame: 20 gauge galvanized steel, 6" wide.
4. Blade: 20 gauge galvanized steel.
5. Control shaft / hand quadrant: 3/8" square axle shaft extending beyond frame through factory mounted, locking hand quadrant.
  - a. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulator shall be equivalent to Sheet Metal Connectors Model RP-3, with heavy-gauge steel regulator, wing nut locking assembly, and stamped dial indicating damper position.
  - b. On externally insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters to avoid damaging or compression of insulation.
6. Bearings: Molded synthetic.
7. Finish: Mill galvanized.
8. Maximum velocity: 1500 fpm.
9. Maximum temperature: 250 deg F.

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C. Multi-Blade Damper:

1. Ruskin model MD35 or equivalent.
2. Frame: 5" x 1" x 16 gauge galvanized steel channel with corner braces. Low profile top and bottom 3-1/2" x 3/8" x 16 gauge galvanized steel channel 13" high and under, actual.
3. Blade: 8" maximum width 16 gauge galvanized steel, opposed blade.
4. Blade stop: 20 gauge galvanized steel.
5. Finish: Mill galvanized.
6. Linkage: Exposed or concealed as recommended by manufacturer.
7. Axles: 1/2" hex.
8. Bearings: Molded synthetic.
9. Control shaft: 3" x 3/8" square plated steel, 1/2" dia. Jackshaft for multisection dampers.
  - a. Jackshaft to operate multi-section damper from one side.
10. Temperature limits: -40 deg F min. to 240 deg F max.
11. Quadrants:
  - a. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulator shall be equivalent to Sheet Metal Connectors Model RP-3, with heavy-gauge steel regulator, wing nut locking assembly, and stamped dial indicating damper position.
  - b. On externally insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters to avoid damaging or compression of insulation.
  - c. Where rod lengths exceed 30 inches, provide regulator at both ends.

D. Bubble tight damper

1. Furnish and install, at locations shown on plans or in accordance with schedules, medium duty industrial grade bubbletight dampers meeting the following specifications. Dampers shall be butterfly type consisting of circular blade, mounted to axle within formed flanged frame. Frame shall be constructed of 304 stainless steel channel with a clean and smooth interior surface. Blade shall be minimum 10 ga. (3.5) thick 304 stainless steel and be complete with full circumference silicone blade seal mechanically attached to blade with full circumference retainer ring. Adhesive seals are not acceptable. Damper shaft shall be continuous 304 stainless steel extending through the entire damper diameter. Stub type axles are not acceptable. The axle shall be supported in 2-bolt nickel plated cast flange bearings with integral shaft seals. Dampers shall be designed and tested for bubbletight leakage performance at 10" wg. pressure. Each damper shall be individually tested for leakage in conformance to AMCA Standard 500-D. Submittal data shall include pressure drop data for full range of damper sizes developed from testing in accordance with AMCA Standard 500 in an AMCA registered laboratory. Data for one size damper is not acceptable. Damper shall be Ruskin model BTR82 with optional wormgear operator with handwheel.

2.6 TAKEOFFS

DUCTWORK ACCESSORIES

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- A. Manufactured high-efficiency takeoff with 45-degree slope on the body, with gauge thickness equal to adjacent ductwork.
  - 1. Damper may be provided with high-efficiency takeoff pending conformance with product requirements for manual balancing dampers.

## 2.7 CABLE REMOTE DAMPER OPERATORS

- A. Manufacturer: United Enertech Corporation or equivalent.
- B. Construction:
  - 1. Bowden Control Wire: 303 stainless steel
  - 2. Remote operator: BO-300

## 3. EXECUTION

### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 13 for duct construction and pressure class.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts and stainless-steel accessories in stainless-steel ducts.
- C. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

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7. Upstream or downstream from duct silencers.
  8. Control devices requiring inspection.
  9. Elsewhere as indicated.
- D. Unless duct access door size is explicitly indicated, provide minimum 24 x 18 inch size duct access doors wherever possible. Provide 18 x 18, 12 x 12 inch or 8 x 8 inch size elsewhere, using the largest size possible.
- E. Install access doors with swing against duct static pressure.
- F. Provide duct test holes where indicated and required for testing and balancing purposes. Install with minimum 24" clear dimension from any side wall or other obstruction.
- G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. Install flexible connectors with adequate flexibility to allow for all thermal, axial, transverse and torsional movement. Provide airtight seal.
- H. Provide balancing dampers at points on supply and exhaust systems where indicated on plans.
- I. Set dampers to fully open position before testing, adjusting, and balancing.
- J. Provide a high-efficiency takeoff with 45-degree entry for each branch connection.
- K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
- L. The use of splitter dampers is not acceptable.

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

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## **SECTION 23 36 50 – LABORATORY AIRFLOW CONTROL SYSTEM**

### **1. GENERAL**

#### **1.1 SYSTEM DESCRIPTION**

- A. The laboratory airflow control system (LACS) shall consist of all components and wiring required to maintain proper laboratory airflow, pressurization, temperature, and ventilated workstation average face velocity, and to implement an integrated system as specified herein and as shown on the Drawings.
- B. The LACS shall be integrated with the existing Owner's controls infrastructure. Points shown on Drawings shall be communicated with the Owner EMCS system via a BACnet-over-IP communication interface. All required components to create seamless communication between the LACS and Owner system shall be included. The LACS shall accept adjustment of setpoints from the Owner system. Coordinate exact requirements with the Owner prior to submitting shop drawings. The Contractor shall verify that the LACS supplier and Controls Contractor provide fully integrated communication between the LACS and EMCS.
- C. The LACS shall control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory ventilated workstation shall be controlled precisely to maintain a constant average face velocity into the ventilated workstation at either a standard/in-use or standby level based on an operator's presence in front of the ventilated workstation. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates and maintain laboratory pressurization in relation to adjacent spaces (positive or negative).
- D. The system shall include room controllers, ventilated workstation airflow monitors, supply and exhaust airflow control devices, reheat coils and valves, all associated low voltage wiring, and all necessary accessories to implement an integrated system as specified herein. System verification and documentation shall also be included.
- E. Subject to compliance with requirements, all laboratory airflow control system components shall be products of a single manufacturer and be the responsibility of that manufacturer. The laboratory airflow control system shall be manufactured by Phoenix Controls Corporation, or equivalent system by Tek-Air.

#### **1.2 QUALITY ASSURANCE**

- A. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of LACS systems and shall be the manufacturer's latest standard design that complies with the specification requirements.

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- B. Parts and labor warranty shall start on the date of substantial completion for a period of 5 years. Any materials or system performance problems shall be corrected by the manufacturer at no cost to the owner during the warranty period.
- C. Supplier shall have an in-place support facility within 300 miles of the site with technical staff, spare parts inventory, and all necessary test and diagnostic equipment.
- D. Installation as well as the startup, checkout and commissioning of the LACS shall be by full time employees of the control system manufacturer and shall be fully trained by the system manufacturer.
- E. Coordinate all work with the Owner's Commissioning Agent.

1.3 SUBMITTALS

- A. Reference specification Section 23 05 00.
- B. The submittal shall include:
  - 1. Manufacturer's product data including all equipment components such as ventilated workstation monitors, controllers, terminal devices, etc.
  - 2. Shop drawings shall include system wiring diagrams with sequences of operation, schedule of air terminal devices with complete sizing data for each device, a system configuration diagram showing all controller types and locations, and a communications network schematic.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store equipment and materials inside and protected from weather.
- B. Where control devices specified in this Section or on Drawings are indicated to be factory-mounted on equipment, arrange for shipping of control devices to unit manufacturer.

**2. PRODUCTS**

2.1 MANUFACTURERS

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- A. This specification is based on the Celeris-2 system by Phoenix Controls Corporation.
- B. Subject to compliance with the specified requirements, the Tek Air system utilizing Accuvalve valves and electronic actuators/controls is an acceptable LACS manufacturer. Any changes required to accommodate the Tek Air system shall be provided at no cost to the Owner. Additionally, all changes to the Drawings must be approved by the Engineer to ensure that the required changes comply with the overall project design and intent.

## 2.2 LABORATORY CONTROL SYSTEM - GENERAL

- A. Each laboratory shall have a dedicated laboratory airflow control system. Each dedicated laboratory airflow control system shall support a minimum of 20 network controlled airflow devices.
- B. The ventilated workstation exhaust airflow control device shall be configured as a 2-position device. One position (“in-use”) shall provide a face velocity of 80 fpm at the ventilated workstation opening when the sash in its lowered position and occupancy is detected in front of the workstation. The second position (“standby”) shall provide a face velocity of 60 fpm at the ventilated workstation opening when the sash in its lowered position and no occupancy is detected in front of the workstation.
- C. The hood exhaust airflow control device shall be switched automatically between in-use and standby levels based on the operator’s presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from the moment of detection with no more than a 5% overshoot or undershoot.
- D. The laboratory airflow control system shall maintain specific airflow ( $\pm 5\%$  of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on the manifold (within 0.3" to 3.0" wc).
- E. The laboratory airflow control system shall use volumetric offset control to maintain room pressurization. See Drawings for the offset values and relative pressurization between spaces. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as varying levels of occupancy at ventilated workstations or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.
- F. The laboratory airflow control system shall maintain specific airflow ( $\pm 5\%$  of signal) with a minimum 16 to 1 turndown to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

## 2.3 AIRFLOW CONTROL DEVICES – GENERAL



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- A. The airflow control device shall be a venturi valve.
- B. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.
- C. The airflow control device shall maintain accuracy within  $\pm 5\%$  of signal over an airflow turndown range of no less than 16 to 1.
- D. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
- E. The airflow control device shall be constructed of one of the following three types:
  - 1. Laboratory supply valves (LSVs) and general exhaust valves (GEVs) shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a Teflon, polyester or PPS (polyphenylene sulfide) composite. All LSVs shall be factory-insulated with closed cell insulation.
    - a. For Tek Air valves, LSVs and GEVs shall have 304 stainless steel valve bodies, compression sections, control surfaces, and shafts.
  - 2. Fume exhaust valves (FEVs) shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
    - a. For Tek Air valves, FEVs shall have 304 stainless steel valve bodies, compression sections, control surfaces, and shafts.
- F. Actuation
  - 1. A UL 916 listed electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications).
  - 2. Constant volume valves do not require actuators, unless required to maintain constant

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airflow.

- G. The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network.
- H. The room-level control network shall utilize a LonTalk communications protocol.
- I. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each laboratory control system shall have the capability of performing ventilated workstation control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.
- J. The laboratory airflow control systems shall have digital integration with the EMCS.
- K. Certification
  - 1. Each airflow control device shall be factory calibrated to the job specific airflows as detailed on the plans and specifications using NIST traceable air stations and instrumentation having a combined accuracy of no more than  $\pm 1\%$  of signal over the entire range of measurement. Electronic airflow control devices shall be further calibrated and their accuracy verified to  $\pm 5\%$  of signal at a minimum of 48 different airflows across the full operating range of the device.
  - 2. Each airflow control devices shall be marked with device-specific factory calibration data. At a minimum, it should include the tag number, serial number, model number, eight-point characterization information (for electronic devices), and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation.

## 2.4 AIRFLOW CONTROL SOUND

- A. Unless otherwise specified, the airflow control device shall not exceed the sound power levels in Paragraphs 2.5.D, 2.5.E, and 2.5.F.
- B. If the airflow control device cannot meet the sound power level specification, a properly sized silencer or sound attenuator must be used. All silencers must be of a packless design (constructed of at least 18 gauge 316L stainless steel when used with ventilated workstation exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20 inches of water.
- C. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance.
- D. Exhaust Airflow Control Device Sound Power Level

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	Exhaust Sound Power Level in dB (re: 10 <sup>-12</sup> watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 CFM Device</b>						
800 CFM @ 0.6" wc	63	55	52	54	50	49
200 CFM @ 0.6" wc	46	42	38	37	32	25
800 CFM @ 3.0" wc	73	70	64	66	65	60
200 CFM @ 3.0" wc	51	52	51	50	52	51
<b>1500-100 CFM Device</b>						
1200 CFM @ 0.6" wc	65	58	53	56	52	52
400 CFM @ 0.6" wc	50	45	38	39	37	31
1200 CFM @ 3.0" wc	72	70	62	65	64	60
400 CFM @ 3.0" wc	55	57	55	53	56	55
<b>3000-200 CFM Device</b>						
2400 CFM @ 0.6" wc	63	56	55	58	54	55
800 CFM @ 0.6" wc	51	45	41	42	39	34
2400 CFM @ 3.0" wc	75	71	65	68	67	63
800 CFM @ 3.0" wc	58	58	56	56	59	58

E. Supply Airflow Control Device Sound Power Level (Discharge)

	Discharge Sound Power Level in dB(re: 10 <sup>-12</sup> watts)					
Octave Band Number	2	3	4	5	6	7
Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 CFM Device</b>						
800 CFM @ 0.6" wc	62	57	54	58	54	51
200 CFM @ 0.6" wc	45	46	42	44	40	34
800 CFM @ 3.0" wc	72	71	67	75	72	68
200 CFM @ 3.0" wc	53	56	54	58	56	54
<b>1500-100 CFM Device</b>						
1200 CFM @ 0.6" wc	63	59	55	60	54	53
400 CFM @ 0.6" wc	53	49	44	49	45	39
1200 CFM @ 3.0" wc	72	73	69	77	72	68
400 CFM @ 3.0" wc	58	63	61	63	60	57
<b>3000-200 CFM Device</b>						
2400 CFM @ 0.6" wc	64	60	58	63	56	56
800 CFM @ 0.6" wc	52	48	47	52	46	41
2400 CFM @ 3.0" wc	75	75	72	78	73	70
800 CFM @ 3.0" wc	59	62	62	66	62	60

F. Supply Airflow Control Device Sound Power Level (Radiated)

	Radiated Sound Power Level in dB (re: 10 <sup>-12</sup> watts)					
Octave Band Number	2	3	4	5	6	7

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Center Frequency in Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
<b>1000-50 CFM Device</b>						
800 CFM @ 0.6" wc	44	41	45	41	36	34
200 CFM @ 0.6" wc	33	28	31	29	26	20
800 CFM @ 3.0" wc	53	53	56	57	55	53
200 CFM @ 3.0" wc	41	38	41	39	39	37
<b>1500-100 CFM Device</b>						
1200 CFM @ 0.6" wc	47	53	40	42	38	36
400 CFM @ 0.6" wc	35	39	31	34	33	26
1200 CFM @ 3.0" wc	52	60	54	60	59	53
400 CFM @ 3.0" wc	42	44	43	46	46	42
<b>3000-200 CFM Device</b>						
2400 CFM @ 0.6" wc	58	56	45	47	43	42
800 CFM @ 0.6" wc	45	43	36	39	37	29
2400 CFM @ 3.0" wc	69	68	60	65	63	57
800 CFM @ 3.0" wc	54	53	48	51	50	48

- G. Discharge and Radiated sound power level data for all terminals shall be available and provided with submittals. The data shall be in accordance with the test procedure in ANSI/ASHRAE 130-1996 standard for ducted air terminal units and all data shall be obtained in a qualified, accredited and ANSI/ASHRAE approved testing laboratory.

2.5 EXHAUST AND SUPPLY AIRFLOW DEVICE CONTROLLER

- A. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.
- B. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-level digital airflow control devices using an industry standard protocol.
- C. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.
- D. The airflow control device shall use industry standard 24 Vac power.
- E. The airflow control device shall have provisions to connect a notebook PC commissioning tool and every node on the network shall be accessible from any point in the system.
- F. The airflow control device shall have built-in integral input/output connections that address ventilated workstation control, temperature control, humidity control, occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:

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1. Three universal inputs capable of accepting 0 to 10 Vdc, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.
2. One digital input capable of accepting a dry contact or logic level signal input.
3. Two analog outputs capable of developing either a 0 to 10 Vdc or 4 to 20 mA linear control signal.
4. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 Vac/Vdc.

G. The airflow control device shall meet FCC Part 15 Subpart J Class A and be UL916 listed.

## 2.6 ADVANCED PRESSURE MONITOR (SENSOR, TRANSMITTER, DISPLAY)

A. Provide pressure-to-current transmitters with the following minimum specifications:

1. Color, touch-screen display
2. Resistant to spray wash-down (rated for use in IP54 environments)
3. Multi-function input signal of 0-10VAC, 0-5VAC or 4-20 mA
4. Standard accuracy RSS of at least +/-0.5% full scale (non-linearity, hysteresis and non-repeatability)
5. Optional high accuracy RSS of at least +/-0.25% full scale (non-linearity, hysteresis and non-repeatability)
6. Integral zero and span adjustment
7. Temperature effect on zero/span shift  $\pm 0.03$  % FS/ $^{\circ}$ F
8. Pressure ranges, selected by engineer shall be up to (-1.0" to +1.0")
9. Temperature Range: 32 to 120 deg. F
10. Programmable visual alarm and adjustable audible alarm
11. Alarm contact output, SPDT, contact rating of 2.0A @ 30VAC/VAC, 0.6A @ 125VAC
12. Acceptable Products
13. Phoenix Controls model APM200
14. Sensors are required as indicated on the drawings

B. Room air pressure sensor plate:

1. Provide shielded static air probes for sensing room pressure levels. Probes shall be flush-mounted in a standard 2" x 4" electrical box.
2. The pressure-sensing tubing shall be connected to the top of the probe with quarter-inch tubing. Tubing shall also be extended from the pressure sensor to a stable common pressure reference port.
3. The exact placement of the sensor plates and means of establishing a stable common reference pressure shall be determined by the engineer.

## 2.7 CONTROL FUNCTIONS

A. The airflow control devices shall utilize peer-to-peer, distributed control architecture to perform room-level control functions. Master-slave control schemes shall not be acceptable. Control functions shall include, at a minimum, pressurization, temperature, humidity control, as well as respond to occupancy and emergency control commands.

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B. Pressurization Control

1. The laboratory control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure. This offset shall be field adjustable and represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.
2. The pressurization control algorithm shall sum the flow values of all supply and exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable.
3. The pressurization control algorithm shall consider both networked devices, as well as:
  - a. Up to three non-networked devices providing a linear analog flow signal.
  - b. Any number of constant volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.
4. Volumetric offset shall be the only acceptable means of controlling room pressurization.
5. The pressurization control algorithm shall support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.

C. Temperature Control

1. The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writeable from the EMCS, with the option of a local offset adjustment.
2. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.
3. Temperature Sensors: Wall-mounted sensor with 10,000-ohm thermistor with an accuracy of +/- 2 Deg. C, temporary override switch, setpoint slider, test-and-balance switch, and 3.5-mm communications jack. Communications jack shall provide access to all LACS setpoints and conditions.

D. Occupancy Control

1. The laboratory control system shall have the ability to change the minimum ventilation and/or temperature control set points, based on the occupied state, in order to reduce

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energy consumption when the space is not occupied. The occupancy state shall be set by the use of the local occupancy sensor. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval. The override interval shall be configurable from one to 1440 minutes. The initial setting shall be set at 120 minutes.

E. Ventilated Workstation Control

1. Airflow devices intended to control the face velocity of a ventilated workstation shall have the ability to interface directly with the ventilated workstation monitoring device. The airflow control device shall:
  - a. Accept command inputs to regulate the flow accordingly and make this command value available to the EMCS.
  - b. Accept a sash position signal and make this value available to the EMCS.
  - c. Accept a Ventilated Workstation Presence Sensor signal to indicate user presence and make this signal available to the EMCS.
  - d. Provide a flow feedback signal to the ventilated workstation monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the EMCS.
  - e. Provide alarm signals to the ventilated workstation monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a local alarm indication. Send alarm signals to EMCS.
2. The ventilated workstation airflow control device shall respond to changes in user presence within one second, in order to provide a constant 80-feet-per-minute face velocity when the ventilated workstation is in use.

F. The laboratory control system shall be segregated into subnets to isolate network communications to ensure room-level control functions and EMCS communications are carried out reliably. Each laboratory space or pressurization zone shall be its own subnet. Commercially available routers shall be used to provide this isolation.

G. The laboratory airflow control system shall support at least 20 networked devices in each pressurized zone.

H. All points shall be available through the interface to the EMCS for trending, archiving, graphics, alarm notification and status reports. Laboratory airflow control system performance (speed, stability and accuracy) shall be unaffected by the quantity of points being monitored, processed or controlled.

I. Refer to the EMCS specification and Drawings for the required input/output summary for the necessary points to be monitored and/or controlled.

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## 2.8 INTERFACE TO ENERGY MANAGEMENT CONTROL SYSTEM

- A. The laboratory airflow control system network shall have the capability of digitally interfacing with the EMCS. The required software interface drivers shall be developed and housed in a dedicated interface device furnished by the laboratory airflow control system supplier. The interface workstation shall be installed in the mechanical penthouse. See Drawings for further information.
  - 1. Provide as many interface workstations as necessary to serve all LACS equipment and devices in the facility, including any existing devices to remain.
- B. All room-level points shall be available to the EMCS for monitoring, trending, and setpoint adjustment. The gateway shall maintain a cache of all points to be monitored by the EMCS. The room-level airflow control devices shall update this cache continually.
- C. The building-level network shall be a high-speed LonTalk (1.25 Mbps) communications protocol. The building-level network shall support up to 100 subnets or pressurization zones, or 6000 data points.
- D. A commercially available interface card shall be provided with the interface workstation in order to connect to the building-level network.
- E. A commercially available network interface card shall be provided with the interface workstation to interface with the EMCS.

## 3. EXECUTION

### 3.1 INSTALLATION

- A. Install all system components in accordance with manufacturer recommendations and requirements.
- B. Coordinate all work with Division 26 Contractor and other trades.
- C. Contractor and LACS Supplier shall coordinate the integration of the EMCS and LACS systems. See Drawings for more information.
- D. Install the interface boxes, presence and motion sensor, and ventilated workstation monitor on the ventilated workstation under initial supervision of the LACS supplier.
- E. Provide and install appropriately sized 24 Vac transformer with secondary circuit breaker suitable for NEC Class II wiring wherever required for a complete, operational system. At minimum, provide one transformer for each router, repeater, or airflow control device actuator. Coordinate 120V power requirements and locations with Div. 26 contractor.



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- F. Install all required routers and repeaters in accessible locations in the spaces that they serve.
- G. Provide and install all required cables. Terminate and connect all cables as required. Utilize cables specifically recommended by the laboratory airflow controls supplier.
- H. Install all airflow control devices in the ductwork and connect all airflow control valve linkages. The use of screws or rivets to connect ductwork to airflow control devices is not allowed unless expressly allowed by the LACS manufacturer and approved by the Engineer or Owner's Representative.
- I. Provide and install all reheat coils and transitions.
- J. Provide and install insulation as required. Insulate all exposed areas of the supply air duct system.

### 3.2 SYSTEM START-UP AND TRAINING

- A. Contractor and LACS Supplier shall coordinate all start-up and training with Owner's Commissioning Agent.
- B. System start-up shall be provided by a factory-authorized representative of the LACS manufacturer. Start-up shall include calibrating the ventilated workstation monitor and any combination sash sensing equipment, as required. Start-up shall also provide electronic verification of airflow (ventilated workstation exhaust, supply, make-up, general exhaust or return), system programming and integration to EMCS.
- C. Notify Owner's Representative a minimum of 14 days prior to system start-up.
- D. Testing, adjusting, balancing of the ventilated workstation face velocity, supply, and general exhaust flows will be done by the TAB contractor. The laboratory airflow control system supplier shall coordinate testing, adjusting and balancing of the laboratory airflow control system with the TAB contractor.
- E. The LACS supplier shall furnish a minimum of eight hours of Owner training by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial ventilated workstation monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.
- F. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

END OF SECTION 23 36 50

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**SECTION 23 40 00 - CONTAINMENT FILTER HOUSING ASSEMBLIES**

**1. GENERAL**

1.1 SECTION INCLUDES

- A. Containment Filter Housings

1.2 REFERENCES

- A. See Section 23 05 00.

1.3 SUBMITTALS

- A. See Section 23 05 00.

1. Provide literature which indicates dimensions, weights, capacities, ratings, gages and finishes of materials, and connection requirements.
2. Provide data of filter media, filter performance data, filter assembly, and filter frames.

1.4 PROJECT RECORD DOCUMENTS

- A. See Section 23 05 00.

1.5 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500. Submit AMCA certification with submittal.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.7 EXTRA MATERIALS

- A. Provide one extra full replacement set of each type of filters for each unit scheduled.

1.8 WARRANTY

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- A. Unit manufacturer to warrant its product to be free of defects in materials and workmanship under normal use when installed and operated in accordance with factory recommendations for a period of 18 months from date of shipment or 12 months after initial equipment start-up, whichever ever occurs first. Equipment found to be defective should be replaced or repaired to include all parts and labor. Component parts that require periodic replacement due to normal wear such as filters, etc. are not covered by the warranty.

## 2. PRODUCTS

### 2.1 CONTAINMENT FILTER HOUSINGS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule.
  - A. General
    - 1. The Containment Filter Housing Assemblies shall be Camfil CamContain series housing units or equivalent that have been fabricated, assembled and pressure decay tested in the same factory. Each system may consist of a combination of the following housing sections and components assembled into a complete containment system:
      - a. Inlet isolation damper
      - b. Inlet transition
      - c. In-place test injection section
      - d. HEPA filter section
      - e. Combination injection and sampling test section
      - f. Second HEPA section
      - g. In-place test sampling section

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- h. Outlet transition
  - i. Outlet isolation damper
  - j. Assembly welded onto a mounting structure
2. The system shall be designed for the scheduled CFM as indicated on the contract documents at 15 inches water gage and the maximum design temperature shall be 130°F. The furnished system shall be sized not to exceed the scheduled “clean” pressure drop across the containment system from inlet flange to outlet flange, including the inlet and outlet bubble-tight dampers. The scheduled “dirty” pressure drop assumes the “clean” HEPA filter initial pressure drop times two plus a maximum final prefilter pressure drop of 1.0” w.g.
3. Sealing Mechanism
- a. FB style Gel Filter Seal
    - i. All high efficiency filters and adsorbers shall be mechanically sealed by means of a gel seal design, which incorporates a knife-edge that mates into the gel filled perimeter channel on the face of the filtering device.
    - ii. The filter sealing mechanisms shall be replaceable and shall be operated through the change-out bag by a locking handle.
    - iii. Prior to leaving the factory, each knife-edge shall be checked with an alignment gage to insure proper alignment with the filter.
    - iv. The mechanism shall exert equal force at the top and bottom edge of the filter when engaging or disengaging the filter at the knife-edge.

2. Bagging Ring

Each filter housing section shall have a bagging ring around each access port. The bagging rings shall have two (2) continuous ribs to secure the PVC filter change-out and scan bags. The outer edge of the ring shall be hemmed to prevent the PVC bag from tearing.

3. Access Doors

- a. The filter access port shall be covered with an access door. Each access port and bagging ring shall be covered by an access door having an extruded silicone gasket that is replaceable (if damaged) after the door has been removed. When closed, the door shall not press against the bag-out port and PVC bag, thus eliminating the possibility of potential leak paths or the bag being cut by pressure from the door to the bag-in bag-out port.

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- b. The filter access door shall have a view port that allows the visual indication of the installation of the change-out bag. (Optional)
- c. Swivel Latches - There shall be four (4) tie down latches per access door. Each latch assembly shall comprise of a 300-series threaded stud and an aluminum star knob. The access door shall provide a means to fit over the threaded stud array and shall be sealed against the filter housing front by tightening the star knobs.

3. Orientation and Handedness

The contract drawings shall determine the filter access side of each housing. The handedness of a housing shall be designated as right hand or left hand. When looking in the direction of airflow (as if standing inside of the housing with the air flow hitting the person's back) of the HEPA filter, if access is required on the right side, then the housing shall be determined to be right hand access. If access is required on the left side from the above stated vantage, then the housing shall be determined to be left hand access.

4. Filter Removal Rods

Multi-wide filter housing sections shall be equipped with a filter removal rod to draw the filters to the change-out position. The removal rod shall be operated from inside the change-out bag and shall remove the filter by pulling against the bottom of the filter frame. There shall not be any penetrations through the pressure boundary of the housing for operation of the removal rod. All change-out operations shall be within the bag so there is always a barrier between the worker and filter.

5. Hardware

All hardware on the filter housing such as the filter clamping mechanism components, door handles, door studs, and labels, shall be 300 series stainless steel. The threaded pivot blocks in the gasket filter clamping mechanisms shall be brass. The standard filter access door knobs are cast aluminum (to prevent galling of threads).

6. Flanges

The upstream and downstream flanges shall have a 1 ½ inch minimum flange width. Flanges shall be turned to the outside of the airstream to prevent contamination build-up and allow the customer to connect mating ductwork from outside of the housing. Bolt hole spacing is in accordance with the recommendation in DOE-HDBK-1169-2003, Nuclear Air Cleaning Handbook (4" inches or less on centers).

7. Welding

- a. All "pressure retaining" weld joints and seams shall be continuously welded. Joints and seams on items such as reinforcement members, shall be intermittently welded. Housing will be free of all burrs, and sharp edges. All weld joints and seams that are a portion of any gasket sealing surface, (duct connection flanges and filter sealing surfaces), shall be ground smooth and flush with adjacent base metals.

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- b. All welding procedures, welders, and welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All welded joints and seams shall be wire brushed to remove heat discoloration. The nondestructive test personnel shall be qualified to the requirements of ANST-SNT-TC-1A. All production welds shall be visually inspected by qualified personnel, in accordance with section 5 and 6 of AWS D9.1, "Specification for Welding of Sheet Metal."

8. Quality Assurance

- a. The filter housing shall be manufactured under a quality assurance program that has been assessed and independently certified to meet the requirements of ISO 9001:2008 for design, manufacture and distribution of containment and HVAC air filtration products. Additionally, filter housing shall be manufactured under a quality assurance program that meets all of the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities". The manufacturer shall submit documented evidence they have been independently audited and successfully passed at least three (3) audits within the last five (5) years to ASME NQA-1 requirements. The final containment filtration system shall be completely fabricated, assembled, tested and cleaned at the manufacturer's facility. Sub-assemblies from outside sources will not be acceptable. The Offeror shall certify their compliance with this paragraph.
- b. The filter housing shall be factory tested for filter fit, operation of filter clamping mechanism, and flatness of gasket filter seal surface. Both the filter sealing surface and the complete assembly pressure boundary shall be leak tested by the "pressure decay method" in accordance with N510-1989 (1995 reaffirmed), "Testing of Nuclear Air Cleaning Systems", paragraphs 6 and 7. The filter sealing surface shall be tested at +10" water gage and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume. The overall system pressure boundary shall be leak tested at +15" water gage and have a maximum leak rate of 0.0005 cfm per cubic foot of housing volume.

9. Service Clearance

A minimum of four (4) feet clearance in front of each access door on the HEPA containment filter assembly shall be reserved for filter replacement and in-place testing.

B. Housing System Components

1. Inlet Isolation Damper

- c. Square Linear-style (This is a more advanced version of the square damper style that eliminates the need for an upstream transition and test section but is limited to having one damper ahead of each filter. Multiple dampers can be connected to a single section but no more than two on one actuator are recommended)
- d. Damper shall be Camfil CamContain Linear Bubble Tight Dish damper, model CF-BTLD series. The damper shall be manufactured from 7 gauge, 14 gauge and 16 gauge type 304/304L stainless steel. The damper shall have a spun stainless steel dish with a receptacle that contains a closed cell silicone sponge gasket. A mating knife-edge shall

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be installed on the damper so that when the damper is actuated, the knife-edge will seal against the gasket.

- e. Damper shall be high-cycle, low torque linear type design. The damper mechanism shall operate linearly, without rotation or pivoting of the damper dish. The required input torque to operate and adequately seal the damper shall not exceed 25 pound-feet per damper width.
  - f. The linear damper design shall be manufactured in accordance with ASME NQA-1 and ISO9001:2008 and qualified by cycle testing the assembly a minimum of 15,000 cycles. A qualified design shall pass the above specified leak test requirements without any adjustments to the assembly, including the gasket, throughout the cycle testing. Evidence of a successfully qualified design shall be furnished prior to bidding.
2. Isolation Damper

- a. Round Blade-style (This is most commonly used option and is most economical using a single round damper for sealing)
- b. Damper shall be Camfil CamContain Bubble-Tight Flat Blade Isolation Damper. The damper shall be manufactured from 7 gauge and 11 gauge type 304/304L stainless steel. The damper shall have (2) 7 gauge 304/304L stainless steel blades with a silicone gasket between them to seal against the inside wall of the damper. The damper shall have a 1- $\frac{1}{2}$ " wide 7 gauge flange on the inlet and outlet with pre-drilled  $\frac{7}{16}$ " mounting holes and  $\frac{1}{4}$ " silicone gasket. Bolt hole spacing is in accordance with the recommendation in DOE-HDBK-1169-2003, Nuclear Air Cleaning Handbook (4" inches or less on centers). The damper shall be adequately reinforced to withstand a negative or positive pressure of 15" water gage.
- c. All 'pressure retaining' weld joints and seams shall be continuously welded with no porosities allowed. Joints and seams requiring only intermittent welds, such as reinforcement members, shall be intermittently welded. Damper shall be free of all burrs, and sharp edges. All weld joints and seams that are a portion of any gasket sealing surface (duct connection flanges), shall be ground smooth and flush with adjacent base metals. All welding procedures, welders and welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All welded joints and seams shall be wire brushed to remove heat discoloration.
- d. The complete pressure boundary of the damper housing shall be leak tested at 15" w.g. per the "Pressure Decay Method" in accordance with ASME N510-1995 Reaffirmed, Testing of Nuclear Air Cleaning Systems. The housing shall not exceed a leak rate of 0.0005 cfm per cubic foot of housing volume. The damper blade shall be tested in the closed position at +10" w.g. and shall be bubble tight when tested in accordance with ASME N509-1995 Reaffirmed, paragraph 5.9.7.3.

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- e. The isolation damper design shall be manufactured in accordance with ASME NQA-1 and ISO9001:2008 and qualified by cycle testing the assembly a minimum of 20,000 cycles. A qualified design shall pass the above specified leak test requirements without any adjustments to the assembly (including the gasket) throughout the cycle testing. Evidence of a successfully qualified design shall be furnished prior to bidding.
  - f. Damper shall be factory equipped with a manual actuator. Actuator shall be equipped with a hand wheel. Actuator shall be a quarter-turn manual worm geared operator. Actuator housings and covers shall be cast iron, worm gears shall be heat-treated carbon steel, hand wheels shall be cast ductile iron, input shafts shall be carbon steel, shaft and shaft seals shall be BUNA-N rubber, housing to cover seals shall be impregnated cellulose fiber, bushings shall be oil impregnated copper nickel steel alloy. The actuator shall be of sufficient capacity to operate the damper under all conditions, and to guarantee tightness of the damper against all system pressures encountered.
3. SafeScan-M: Downstream Non-intrusive Scanning Section
- a. The Camfil CamContain SafeScan-M section shall be non-intrusive and shall not require the external pressure boundary of the housing to be breached in order to conduct a scan test of the filter element. The non-intrusive scan system shall be designed to perform in-place scan testing of HEPA filter(s) by traversing the scan probes across the full face of the filter and the perimeter filter-to-housing seal surfaces. The scanning process shall be accomplished by mechanically positioning the probes from the exterior of the containment system without removing an access door or access cover or otherwise breaching the exterior pressure boundary of the housing. The probe assembly and scan testing process shall be designed and validated to meet the intent of IEST-RP-CC001.4 for scan testing type C HEPA filters. All probe assembly, sample ports and mechanical scan test components of the safe scan retrofit system shall be manufactured 304/304L stainless steel, polycarbonate, polyurethane, ABS or other materials that are chemically compatible with vaporous hydrogen peroxide, chlorine dioxide and paraformaldehyde decontamination agents.
  - b. The drive assembly shall be self-lubricating and not require oiling or greasing of mechanical components in order to maintain operability over the service life of the equipment. The drive assembly and associated components shall be manufactured from 304/304L stainless steel, polycarbonate, polyurethane, ABS, Teflon or other materials that are chemically compatible with vaporous hydrogen peroxide, chlorine dioxide and paraformaldehyde decontamination agents. Penetrations through the pressure boundary of the housing that may be required for the drive assembly, the scan assembly and associated hardware shall be sealed such that they meet the pressure decay requirements.
  - c. The scan probe assembly shall consist of a drive assembly and a probe assembly coupled to the drive assembly. The drive assembly shall be designed and installed such that it will be operated from outside of the housing, causing the probe assembly to move linearly such that the probe transverses the entire face of the filter element which is being scanned. The opening of the probe assembly where the sample is taken shall be parallel



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to the face of the seal surface of the housing within 5 degrees. The opening of the probe assembly shall also be maintained at a maximum distance of 1" from the plane of the filter/housing seal surface and shall maintain a uniform distance as the probe traverses across the housing with maximum variation in distance from the plane of the filter/housing seal surface of  $\pm 0.125$ ".

- d. The scan probe assembly shall meet the intent of IEST-RP-CC-034.3 regarding "overlapping" strokes when scan testing. This requirement ensures that the entire face area of the media is scanned. The probe assembly shall be designed, installed, and operate such that the entire face area of the filter media as well as the filter-to-housing seal is scanned in order to ensure that there is no bypass leakage around the filter element. The scan probe assembly shall consist of a minimum of two (2) individual scan probes for a half high size filter system and four (4) individual scan probes for a full size high filter system. The aperture or opening of a scan probe shall be designed such that the sample velocity into the probe is 225 fpm  $\pm 10\%$ . Each scan probe shall be connected to a quick release fitting installed on the front of the housing using flexible tubing and stainless steel hardware. The scan probe assembly shall be manufactured from chemical resistant, static dissipative polycarbonate and the flexible tubing shall be manufactured from static dissipative polyurethane. Both shall be chemically compatible with vaporous hydrogen peroxide, paraformaldehyde and chlorine dioxide decontamination agents.
- e. The quick-release fittings installed on the exterior of the door connected to the scan probes via the flexible tubing shall be manufactured from polypropylene or materials that are chemically compatible with vaporous hydrogen peroxide, paraformaldehyde and chlorine dioxide decontamination agents. The quick-release fittings shall feature an integral bubble-tight check valve with EPDM seals. The fitting design shall be such that accidental or inadvertent operation of the check valve is not possible without the use of tools, appliances, or other hardware.

## C. COMMON HOUSING ACCESSORIES

### 1. Transitions

- a. Each containment system shall be fitted with reducing transitions.
- b. Transitions shall be constructed of 304/304L stainless steel and designed with reinforcement to withstand a negative or positive working pressure of 15" water gauge. The minimum acceptable sheet metal thickness shall be 16-gauge. They shall be attached to the filter system by continuous seal welding. Integrated duct connection flanges on the transition shall be a 1-1/2" inch wide 7-gauge plate flange. The flange on the transitions shall have pre-drilled 7/16" mounting holes and bolt hole spacing in accordance with the recommendation in DOE-HDBK-1169-2003, Nuclear Air Cleaning Handbook (4" inches or less on centers).

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## 2. Decontamination Port Assembly

These ports shall be installed on each filter train as shown on the drawings and shall be compatible with the User's decontamination equipment. Unless otherwise specified, each port shall consist of a reinforcement plate welded to the housing side wall, 3 inch IPS Schedule 40, stainless steel pipe, 3 inch IPS stainless steel pipe flange, 3 inch IPS butterfly valve and 3 inch female IPS aluminum hose connection with dust plug. The butterfly valve shall be wafer style, lever operated, and shall be bubble-tight at 150 psi. It shall have a cast iron body, stainless steel disc, stainless steel stem and EPDM seat.

## 3. Change-out Bags

- a. One (1) PVC change-out bag shall be furnished for each access port. Each bag shall have its stock number rolled in the hem. The PVC bag material shall be 8 mil thick, yellow in color, with a translucent, taffeta textured finish and shall not stick together.
- b. For visibility during filter change-out, this bag shall include approximately 16 inches of clear PVC at the mouth. Three (3) glove sleeves shall be built into the bag to facilitate handling during the filter during change-out.
- c. All PVC bags of this design shall be produced by filter housing manufacturer and shall have been tested by an independent laboratory to prove the bag's operability at extreme temperature ranges of 0°F - 130°F (a test report verifying this test shall be furnished upon request). An elastic shock cord shall be hemmed into the mouth of the bag so that it fits securely when stretched around the bagging ring. To prevent the bag from sliding off the bagging ring during the change-out operation, one (1) polypropylene security strap shall be provided with each filter access port. Additionally, one (1) polypropylene cinching strap shall be provided with each access port to tie off the slack in the PVC bag while the ventilation system is operating.

## 4. Differential Pressure Gages

- a. Differential pressure gages shall be Dwyer Series 2000 Magnehelic pressure gage or equal. Unless otherwise indicated select gage scale ranges to read at 75 percent full range (rounded up) at the expected dirty filter pressure drop. Typical ranges follow:
  - i. Filters with 25 to 30% efficiency 0 - 1.0 inches water column based on atmospheric dust spot test
  - ii. Filters with 31 to 99% efficiency 0 - 3.0 inches water column based on atmospheric dust spot
  - iii. HEPA filters 0 - 3.0 inches water column

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- iv. Overall \*specified based on total dirty system pressure drop
- b. Gages shall be furnished for each filter bank, including gages across each individual filter bank in built-up rack assemblies, suitable for flush mounting in a panel. All sensing tubing shall be ¼ inch O.D. copper tubing or stainless steel tubing.
- c. Differential Pressure Gage Ports

Static pressure ports shall be located on the filtration unit upstream and downstream of each prefilter, HEPA filter, HEGA and Overall System banks. The port connections shall be 1/4 inch 300 series stainless steel pipe half-couplings with brass plugs.

- d. In-Line Gage HEPA Filters
  - i. In-line gage HEPA filter shall be Camfil Gage Guardian air filter, designed to protect diaphragm pressure indicating instrumentation (i.e. Magnehelic Gages, Photohelic Gages, etc.) from particulate contaminants.
  - ii. Due to life safety concerns, and considering that the integrity of the pressure boundary of these filters is as critical as that of the containment housing, each filter shall be factory tested to assure it is leak free and bubble-tight at a pressure of +20" w.g. by submerging the entire filter assembly in water, pressurizing the assembly to +20" w.g. and visually inspecting for leaks. The presence of a single bubble generated by this method constitutes a leak. Each filter shall have a label indicating that it was leak tested. The filter media shall be hydrophobic with a minimum efficiency of 99.9995%. The filter body shall be manufactured from 304/304L stainless steel with silicone gaskets or O-rings to ensure long service life. All wetted surfaces of the filter shall be chemically compatible with vaporous hydrogen peroxide, chlorine dioxide and paraformaldehyde decontamination agents.
- e. Gage Decontamination Ports

These ports shall be installed in the gage lines between the containment housing and gage(s) as shown on the drawings and shall be compatible with commercially available vaporous hydrogen peroxide, chlorine dioxide and paraformaldehyde decontamination systems. Each port shall consist of a stainless steel ball valve with a 3/8" female NPT connection allowing for connection to commercially available paraformaldehyde or vaporous hydrogen peroxide decontamination system to enable decontamination of the gage lines and in-line HEPA filter.

- f. Gage Calibration Line

As shown on the drawings, stainless steel shutoff valves shall be provided to isolate each gage from the process stream. A stainless steel equalization valve shall be installed between the high and low pressure sides of each gage in such a manner that when the shutoff valves

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are closed, and the equalization valve is open, the pressure across the gage equalizes for calibration purposes without the possibility of venting to the ambient space. Shutoff and equalization valves shall be 300 series stainless steel.

1. HEPA Filter (Very High Capacity) – Absolute XH

a. General

- i. Air filters shall be HEPA grade high-capacity air filters with waterproof micro glass fiber media, tapered corrugated aluminum separators, urethane sealant, 16-gauge steel enclosing frame, and (neoprene sealing gasket or seamless gasket)
- ii. Sizes shall be as noted on drawings or other supporting materials.

b. Construction

- i. Filter media shall be one continuous pleating of micro glass fiber media.
- ii. Pleats shall be uniformly separated by tapered corrugated aluminum separators incorporating a hemmed edge to prevent damage to the media.
- iii. The media pack shall be potted into the enclosing frame through the use of a urethane sealant.
- iv. The enclosing frame of the 16-gauge steel with a zinc aluminum alloy finish, shall be bonded to the media pack to form a rugged and durable enclosure. The filter shall be assembled without the use of fasteners to assure no frame penetrations. Overall dimensional tolerances shall be correct within  $-1/8"$ ,  $+0"$  and square within  $1/8"$ .
- v. A poured in place seamless gasket shall be included on the downstream side of the enclosing frame to form a positive seal upon installation.

c. Performance

- i. Filter efficiency shall be 99.99%, when evaluated according to the IEST Recommended Practice. Each filter shall be labeled as to tested performance.
- ii. Initial resistance shall be 1.35" w.g. target at rated airflow.
- iii. Filter shall be qualified as UL 900 per Underwriters Laboratories.
- iv. The filter shall be capable of withstanding 10" w.g. differential without failure to the media pack.
- v. Manufacturer shall provide evidence of facility certification to ISO 9001:2008.

d. Supporting Documentation

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- i. The filter shall be labeled as to tested efficiency, rated/tested cfm, pressure drop and shall be serialized for identification.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install containment air filtration system in accordance with manufacturer's instructions and applicable sections of ASME N-509, and in accordance with the manufacturer's diagrams and recommendations.
- B. Clean all dirt, dust and debris that may be in the containment system or attached ductwork during construction and installation.
- C. The HEPA filters and adsorbers shall be shipped separately and must be handled carefully to prevent damage and stored in a safe, dry space until ready for installation. The filter train shall be installed, cleaned and operated for a minimum of one hour prior to any filter installation. The filters must be handled carefully during storage and installation.
- D. Refer to details on the drawings for different configuration requirements.

#### **3.2 WELDING**

- A. Welding procedures, welders, and welding operators shall be qualified in accordance with ASME BPVC SEC IX. All welding performed shall meet the requirements specified in ASME BPVC SEC IX and as required by ASME N509. Pressure retaining weld joints shall comply with the requirements of ASME BPVC SEC IX.

#### **3.3 FACTORY QUALITY ASSURANCE PROGRAM**

- A. The filter housing shall be manufactured under a quality assurance program that has been assessed and independently certified to meet the requirements of ISO 9001:2008 for design, manufacture and distribution of containment and HVAC air filtration products.
- B. Additionally, the transitions and/or plenums, housings, test sections and mounting components shall be manufactured and inspected under a Quality Assurance Program that meets all of the basic requirements of ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities". The manufacturer shall submit documented evidence they have been audited by customers at least three (3) times to these requirements and successfully passed all three (3) audits within the past five (5) years.
- C. All production welds shall be visually inspected to assure that they meet the workmanship acceptance criteria described in Sections 5 and 6 of AWS D9.1M/D9.1:2006, Specification for Welding of Sheet Metal or ASME Boiler and Pressure Vessel Code Section IX.

#### **3.4 FACTORY ACCEPTANCE TESTS**

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- A. All acceptance tests shall be in accordance with the procedures in ASME N510-1989 (1995 reaffirmed). Proposed test schedules for adjusting and balancing, housing leak and pressure, air-aerosol mixing uniformity, damper operation and leakage, system bypass, and performance tests of systems, shall be provided at least 2 weeks prior to the start of related testing.
- B. Visual Inspection
  - 1. Visual inspection shall be performed in accordance with ASME N510-1989 (1995 reaffirmed)
- C. Housing Leak and Pressure Test
  - i. HEPA Filters: Pressurize housing to a minimum of 9.0-inch wg and test housing joints, door seals, and sealing edges of filter for air leaks according to pressure-decay method in ASME AG-1.
  - b. Air filter will be considered defective if it does not pass tests and inspections.
  - c. Prepare test and inspection reports.
  - 2. Damper Operation and Leakage Test
    - a. The damper shall be tested to verify that it operates as specified. The air leakage rate through loose isolation dampers shall be measured and recorded. The damper shall be functionally tested as required in ASME N510-1989 (1995 reaffirmed).
  - 3. System Bypass Test
    - a. The filtration element housing and housing seal shall be tested in accordance with ASME N510-1989 (1995 reaffirmed). The maximum housing leakage rate acceptance criteria shall be 0.0005 cfm per cubic foot of housing volume at 9 inches of water gauge pressure differential.

3.5 PREPARATION FOR SHIPPING

- A. The filtration system shall be mounted with protective shipping skids, crated or covered, blocked, braced, and cushioned as necessary to prevent physical damage during shipping.

**END OF SECTION**

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**SECTION 23 82 16 - AIR COILS**

**1. GENERAL**

1.1 SECTION INCLUDES

A. Water coils.

1.2 REFERENCE SECTION 23 05 00 FOR THE FOLLOWING:

A. Quality assurance.

B. References.

C. Submittals.

D. Operation and maintenance manuals.

E. Project record documents.

F. Delivery, storage, and handling.

G. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

H. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.3 FIELD CONDITIONS

A. Altitude above Mean Sea Level: 1080 feet.

**2. PRODUCTS**

2.1 WATER COILS

A. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

B. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

C. Source Quality Control: Factory tested to 300 psig.



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- D. Tubes: ASTM B 743 copper, minimum 0.020 inch thick. Tube Diameter: 0.50 inch.
- E. Fins: Aluminum, minimum 0.010 inch thick.
- F. Minimum Fin Spacing: 144 max fins/foot
- G. Headers: Seamless copper tube with brazed joints, prime coated.
- H. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.
- I. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
- J. Frames: Galvanized-steel channel frame, minimum 20 gauge thickness. Contractor to determine slip-in or flanged mounting preference.
- K. Coil Capacities
  - 1. Refer to equipment schedules on drawings for capacity and sizing information

### 3. EXECUTION

#### 3.1 INSTALLATION

- A. Install coils level and plumb and in accordance with manufacturer's instructions.
- B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- C. Support coil sections independent of piping on steel channel or double angle frames and secure to casings. Provide frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Provide airtight seal between coil and duct or casing.
- D. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- E. Make connections to coils with unions and flanges.
- F. On water coils, provide shut-off valve on supply line and lockshield balancing valve on return line. Locate water supply at bottom of supply header and return water connection at top. Provide manual air vents at high points complete with stopvalve. Ensure water coils are drainable and provide drain connection at low points.

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- G. Connect water supply to leaving air side of coil (counterflow arrangement).
- H. Insulate headers located outside air flow as specified for piping.

END OF SECTION 23 82 16

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## SECTION 26 05 00 - ELECTRICAL GENERAL PROVISIONS

### 1. GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1-specification sections, apply to work of this Section.

#### 1.2 DESCRIPTION OF WORK

- A. The work included under this Section consists of providing all labor, materials, supervision, and construction procedures necessary for the installation of the complete electrical systems required by these specifications and/or shown on the drawings of the contract.
- B. The Contract Drawings are shown in part diagrammatic intended to convey the scope of work, indicating the intended general arrangement of equipment, conduit, and outlets. Follow the drawings in laying out the work and verify spaces for the installation of the materials and equipment based on the dimensions of actual equipment furnished. Whenever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Engineer before proceeding with the work.
- C. Portions of this facility (as indicated on the drawings) are classified as Bio Safety Level 3 (BSL3) and Animal Bio Safety Level 3 (ABSL3). All penetrations into the BSL3/ABSL3 area must be adequately sealed as outlined within the drawings and these specifications and per the National Institutes of Health (NIH) Design Requirements Manual.**

#### 1.3 QUALITY ASSURANCE

Installers shall have at least 2 years of successful installation experience on projects with electrical installation work similar to that required by the project. All equipment and materials shall be installed in a neat and workmanlike manner and shall be aligned, leveled, and adjusted for satisfactory operation.

#### 1.4 REFERENCES

- A. The design, manufacture, testing, and method of installation of all equipment and materials furnished under the requirements of this specification shall conform to the following codes, standards and regulations, etc.:
1. Safety and Health Regulations for Construction.
  2. Occupational Safety and Health Standards, National Consensus Standards and Established Federal Standards.
  3. National Electrical Code (NEC).
  4. American National Standards Institute (ANSI).
  5. National Electric Manufacturer's Association (NEMA).
  6. Institute of Electrical and Electronic Engineers (IEEE).

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7. National Fire Protection Association (NFPA).
8. Insulated Cable Engineers Association (ICEA).
9. American Society for Testing and Materials (ASTM).
10. Life Safety Code NFPA #101.
11. Underwriters Laboratories, Inc. Standards (UL).
12. Factory Mutual Engineering Corporation or other recognized National Laboratories.
13. National Electrical Safety Code (NESC).
14. National Institutes of Health (NIH) Design Requirements Manual (DRM),

- B. The latest adopted edition by the local and state inspection authorities of all standards and specifications listed above shall apply.
- C. Furthermore, the electrical work shall be in accordance with all applicable National and State Standards, and Local Codes and Building Ordinances. The electrical work shall merit the approval of the enforcing authorities having jurisdiction.

#### 1.5 MATERIALS AND EQUIPMENT

- A. Electrical materials and equipment for the entire project shall meet the requirements specified under the Supplementary Conditions Section of this specification.
- B. Equipment and fixtures shall be connected to provide circuit continuity in accordance with applicable Codes whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures and the point of circuit origin.
- C. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify all connection details.
- D. All equipment over 50 pounds shall be provided with adequate lifting means.

### 2. PRODUCTS (NOT USED)

### 3. EXECUTION

#### 3.1 ACCESS TO EQUIPMENT

- A. Starters, switches, receptacles, pull boxes, etc. shall be located to provide easy access for operation, repair and maintenance. If the devices listed above are concealed, access doors shall be provided.

#### 3.2 SUBMITTALS

- A. Test Reports: Provide the tests as outlined in this specification and all other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each electrical system. Provide the Engineer with a complete schedule of all tests.

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1. Final Tests: Start final tests after complete preliminary tests have been made which indicate adequacy, quality, completion, and satisfactory operation of all electrical systems. Included in these tests are the following:
    - a. Completion of the form "Electrical Test Report" (attached to the end of this specification section) in sufficient quantity to provide the indicated information for each panelboard and switchboard in the project.
    - b. Completion of the form "Motor Test Report" (attached to the end of this specification section) in sufficient quantity to provide the indicated information for all three phase motors.
  2. The Contractor shall submit the above completed reports to the Engineer, noting all deviations from the requirements listed below:
    - a. Plus or minus five percent variation between nominal system voltage and no load voltage, or plus or minus five percent variation between no load and full load voltage.
    - b. Plus five-percent variation between rated and actual motor current.
    - c. Plus or minus ten percent variation between average phase current and measured individual phase current. The Contractor shall balance phase currents of all distribution equipment within the tolerances specified.
    - d. Insulation resistance between conductors and ground of not less than 1,000,000 Ohms.
  3. Final Corrections: Correct promptly any failure or defects revealed by these tests as determined by the Engineer. Reconduct tests on corrected items as directed by the Engineer.
- B. Operation and Maintenance Manuals: Operation and Maintenance Manuals shall be provided according to Division 1 requirements. In general, during the time of the contract, and before substantial completion of the electrical installation, submit to the Engineer the number of copies described in the Division 1 specifications and the General and Supplemental Conditions copies of descriptive literature, maintenance recommendations (from the equipment manufacturer), data on initial operation, wiring diagrams, performance curves, engineering data and tests, operating procedures, routine maintenance procedures, and parts lists for each item of electrical equipment installed under this contract and submit all manufacturer's guarantees and warranties.
- C. Shop Drawings: The Contractor shall furnish shop drawing portfolios and proper transmittal forms for all materials, equipment, and lighting fixtures to be incorporated in the work in accordance with the General Conditions, Supplementary Conditions, and all other applicable Conditions.
1. Shop drawings on component items forming a system or that are interrelated shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function properly as a system. A notation shall be made on each shop drawing submitted as to the item's specific use, either by a particular type number referenced on the drawings or in the specifications, by a reference to the

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applicable paragraph of the specifications, or by a description of its specific location. The shop drawings shall be organized and bound into sets with each set collated.

2. The Engineer shall have the final authority as to whether the equipment or material submitted is equal to the specified item. Proposed substitutions may be rejected for aesthetic reasons if felt necessary or desirable. In the event the proposed substitutions are rejected, the Contractor shall furnish the specified item.

### 3.3 EXISTING UTILITIES

- A. The Contractor shall verify the location of all existing utilities with the Owner and Utility providers prior to commencing excavation work. In addition, the contractor is responsible for locating and maintaining all existing utilities without damage. Fully coordinate all new underground utility work with existing utilities on the site. The drawings and survey data of the contract documents indicate the available information on the existing power and communication services, and on new services to be provided to the project by utility provider. Accuracy of this information is not assured.

### 3.4 SMOKE AND SMOKE/FIRE DAMPERS

**Provide all necessary duct detectors for smoke and smoke/fire dampers.** In addition, provide all necessary connections, including power supply circuits (fed from the nearest panelboard, emergency if available, of the appropriate voltage unless indicated otherwise on the drawings) to smoke dampers and smoke/fire dampers so that upon fire alarm conditions or integral smoke detector activation, the dampers close. Coordinate damper and control locations with the mechanical and controls contractors. Refer to the mechanical drawings for damper schedule and locations.

### 3.5 ELECTRICAL-MECHANICAL EXTENT OF WORK

- A. The responsibility of work specified under Divisions 21, 22, 23 and 26 is clarified under, Sections 21 05 00, 22 05 00 and 23 05 00. Said Sections are incorporated herein by reference.

### 3.6 ELECTRICAL PRODUCT COORDINATION

- A. Refer to Division 2 through Division 32 and the electrical drawings for the power characteristics required and available for the operation of each power-consuming item of equipment. Coordinate purchases to ensure uniform interface with every item requiring electrical power.

### 3.7 CUTTING AND PATCHING

- A. The Electrical Contractor shall be responsible for all cutting and patching of holes in building construction which are required for the passage of electrical work. Cutting and patching shall conform to the requirements of Division 1 and, if applicable, Division 2 of these specifications.
- B. Cutting of structural framing, walls, floors, decks and other members intended to withstand stress is not permitted.

### 3.8 PAINTING, FINISHING

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- A. Painting of electrical work exposed in occupied spaces, except mechanical and electrical machine rooms and maintenance/service spaces; and work exposed on the exterior of the facility is specified and performed under other divisions of these specifications.
- B. Factory finishes, shop priming, and special protective coatings are specified in the individual equipment specification sections.
- C. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

3.9 EXCAVATION AND BACKFILLING

- A. Contractor shall perform all excavation and backfilling necessary to install the required electrical work. Coordinate the work with other excavating and backfilling work in the same area. Except as indicated otherwise, comply with the applicable sections in Division 31 of these specifications, excavation filling and backfilling (for structures) to 5' outside the building line, and exterior utilities sections for beyond 5' from the building line.
- B. Landscape work, pavement, flooring and similar exposed finish work that is disturbed or damaged by excavation shall be repaired and restored to their original condition by the Contractor.

3.10 CONDUITS AND SUPPORT, GENERALLY

- A. Conduits, except electrical conduits run in floor construction, shall be run parallel with or perpendicular to lines of the building unless otherwise noted on the drawings. Electrical conduits shall not be hung on hangers with any other service, unless specifically approved by the Engineer. Electrical conduits shall be hung above all other service pipes. Hangers on different service lines running close to and parallel with each other shall be in line with each other and parallel with, or perpendicular to, the lines of the building. Exact location of electric outlets, piping, ducts, and the like shall be coordinated to avoid interferences between lighting fixtures, piping, ducts, and similar items.

3.11 ACCESS PANELS

- A. Furnish and install panels for access to junction boxes and similar items where no other means of access, such as a readily removable, sectional ceiling is shown or specified.
- B. Panels shall not be less than 12-inches by 16-inches in size. Larger panels shall be furnished where required. Panels in tile or other similar patterned ceilings shall have dimensions corresponding to the tile or pattern module.
  - 1. Refer to Section 08 31 13 – Access Doors and Panels for specific information on type and size of panels



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### 3.12 INSTALLATION OF EQUIPMENT

- A. Install and connect all appliances and equipment as specified and indicated for this project, in accordance with the manufacturers' instructions and recommendations. Furnish and install complete electric connections and devices as recommended by the manufacturer or required for proper operation.

### 3.13 ELECTRICAL DEMOLITION

- A. Refer to Division 01 Sections for general demolition requirements and procedures.
- B. Refer to the drawings for additional demolition requirements.
- C. Disconnect, demolish, and remove electrical systems, equipment and components specified under Divisions 26, 27 & 28 and as indicated on the drawings.
  - 1. For conductors serving devices shown to be removed: Disconnect the device and remove all conduit and conductors back to the panel or to the next device shown to remain or as required by actual circuiting.
  - 2. Coordinate all phasing and related electrical system outages with the Owner and all other disciplines.
  - 3. For mechanical equipment indicated shown to be removed on either the mechanical and/or the electrical plans: Disconnect the equipment and remove all conduit, conductors and associated electrical supply equipment. Remove conduit and conductors back to the panel or the next device shown to remain or as required by actual circuiting.

### 3.14 COORDINATION

- A. Coordinate the electrical work with work of the different trades so that:
  - 1. Interferences between mechanical, electrical, architectural, and structural work, including existing services, will be avoided.
  - 2. Within the limits indicated on the drawings, the maximum practicable space for operation, repair, removal and testing of electrical and other equipment will be provided.
  - 3. Pipe, conduits, ducts, and similar items, shall be kept as close as possible to ceiling, walls, and columns, to take up a minimum amount of space. Pipes, conduits, ducts, and similar items shall be located so that they will not interfere with the intended use of other equipment.
- B. Furnish and install, without additional expense to the Owner, all offsets, fittings and similar items necessary in order to accomplish the requirements of coordination.
- C. Any work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interference's shall be made without additional expense to the Owner.

### 3.15 SINGULAR NUMBER

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- A. Where any device or part of equipment is herein referred to in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

3.16 WARRANTY

- A. Refer to the General Conditions section of this Specification for warranty requirements and information.

3.17 CLOSE OUT AND OPERATION INSTRUCTIONS

- A. Sequence operations properly so that all work of this project will not be damaged or endangered. Operate each item of equipment and each system in a test run of appropriate duration to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance.
- B. Conduct a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of electrical equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, security, safety, efficiency and similar features of the systems.
- C. At the time of substantial project completion, turn over the prime responsibility for operation of the electrical equipment and systems to the Owner's operating personnel. Until the time of final acceptance, provide full time operating personnel, who are completely familiar with the work, to consult with and continue training the Owner's personnel.

SUBSTITUTIONS

- D. All proposals shall be based on providing and installing the materials or items of equipment which are hereinafter specified by name and/or manufacturer. Substitutions, for materials or items of equipment specified, will not be allowed, unless approved by Engineer prior to (10 days before) bid date.
- E. Refer to Instructions to Bidders for complete requirements for substitutions.

3.18 AS-BUILT DRAWINGS

- A. Contractor shall provide the Owner with as-built drawings for all electrical systems as described in these specifications and/or shown on the Drawings.

END OF SECTION 26 05 00

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## MOTOR TEST REPORT

DATE: \_\_\_\_\_  
 SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_  
 PROJECT NUMBER: \_\_\_\_\_

DESIGNATION						
LOCATION						
HORSEPOWER						
NEMA STARTER SIZE						
MAXIMUM HEATER AMPS						
MEASURED CONDITIONS	PHASE			PHASE		
	A	B	C	A	B	C
ACTUAL MOTOR CURRENT						
NAMEPLATE MOTOR CURRENT						
NO LOAD VOLTAGE						
FULL LOAD VOLTAGE						

DESIGNATION						
LOCATION						
HORSEPOWER						
NEMA STARTER SIZE						
MAX HEATER AMPS						
MEASURED CONDITIONS	PHASE			PHASE		
	A	B	C	A	B	C
ACTUAL MOTOR CURRENT						
NAMEPLATE MOTOR CURRENT						
NO LOAD VOLTAGE						
FULL LOAD VOLTAGE						

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## ELECTRICAL TEST REPORT

DATE: \_\_\_\_\_  
 SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

PROJECT NAME: \_\_\_\_\_  
 PROJECT NUMBER: \_\_\_\_\_

SERVICE TRANSFORMER SIZE	
NO LOAD SERVICE VOLTAGE	
FULL LOAD SERVICE VOLTAGE	

DESIGNATION									
LOCATION									
MEASURED CONDITIONS	PHASE			PHASE			PHASE		
	A	B	C	A	B	C	A	B	C
NO LOAD FEEDER VOLTAGE									
OPERATING LOAD FEEDER VOLTAGE									
OPERATING LOAD FEEDER CURRENT									

DESIGNATION									
LOCATION									
MEASURED CONDITIONS	PHASE			PHASE			PHASE		
	A	B	C	A	B	C	A	B	C
NO LOAD FEEDER VOLTAGE									
OPERATING LOAD FEEDER VOLTAGE									
OPERATING LOAD FEEDER CURRENT									

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## **SECTION 26 05 01- BASIC MATERIALS AND METHODS**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this Section.

#### **1.2 DESCRIPTION OF WORK**

- A. The extent of Basic Materials and Methods is indicated by the drawings and specifications. Basic materials are defined but not limited to cable and conduit seals, outlet boxes, pull boxes, conduit fittings, safety switches, and fuses.

#### **1.3 QUALITY ASSURANCE**

- A. **Manufacturers:** All materials shall be new, unused, and unweathered, and of the quality specified. Materials shall be standard products of manufacturer's regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
- B. **Installer:** All equipment and materials shall be installed in a neat and workmanlike manner, shall be complete in both effectiveness and appearance, whether finally concealed or exposed and shall be executed by experienced mechanics.

#### **1.4 REFERENCES**

- A. The electrical work shall conform to all applicable sections of standards, codes and specifications promulgated by organizations listed below.
  - 1. Occupational Safety and Health Standard, National Consensus Standards and Established Federal Standards
  - 2. National Electrical Code (NEC)
  - 3. National Electric Manufacturer's Association (NEMA)
  - 4. American Society for Testing of Materials (ASTM)
  - 5. Underwriters Laboratories, Inc. Standards (UL)
  - 6. Factory Mutual Engineering Corporation or other Recognized National Laboratories

#### **1.5 SUBMITTALS**

- A. **Shop drawings:** Prepare a set of shop drawings showing manufacturers product data for all component parts specified in this Section.

### **2. PRODUCTS**

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- 2.1 Equipment and Materials Furnished by Others: Certain materials and equipment for this project will be furnished under other divisions. These materials and equipment, which are shown or noted on the plans, will be installed and/or connected under this Division. It shall be incumbent upon this Contractor to become familiar with all of the materials and equipment that will be furnished under other Divisions, but which will be installed and/or connected under this Division.
- 2.2 Cable and Conduit Seals: Seals shall be provided around all conduits and cables which penetrate smoke walls, fire walls, and floors. Nelson Flameseal System shall be used to seal penetrations of electrical cables and conduits.
- A. Materials used shall be flameseal putty, ceramic fiber insulation and where rigid support on large oversized openings is required, ceramic fiber board. Board shall be rigid and able to withstand temperatures in excess of 2000 degrees F.
- B. Accessory hardware shall be provided as required on oversized openings.
- C. Follow manufacturers instructions in selecting the type of seals and accessories. Also follow the manufacturers instructions on installation of the cable and conduit seals. Equal quality equipment by OZ Gedney and 3M shall be acceptable.
- 2.3 **BSL3/ABSL3 Area Sealants: All penetrations into the BSL3/ABSL3 area and containment area environments, including all conduits, cables, boxes, electrical devices, etc. shall be adequately sealed to maintain the environment. ASTM C920 compliant sealing and caulking compound shall be used to seal around all raceway, cable and box penetrations through BSL3/ABSL3 Area walls, ceilings and floors. Provide 100% silicone sealant between all surface mounted electrical devices and finished walls and ceilings within the BSL3/ABSL3 Area. Provide 100% silicone sealant between flush mounted electrical device faceplates and finished walls and ceilings within the BSL3/ABSL3 Area. Provide non-halogenated latex-based elastomeric sealant along the perimeter of the lighting fixture housings where the housing of the fixture penetrates the BSL3/ABSL3 area ceiling. No additional caulking is required around the perimeter of the flange of the fixture. Reference electrical details for additional sealant and caulking information.**
- 2.4 Outlet Boxes, Pull Boxes and Conduit Fittings: Furnish and install outlet boxes, pull boxes, and conduit fittings as described below. Catalog numbers shown are Appleton Electric Company; Steel City, O.Z. Gedney, and Raco, are equally acceptable.
- A. OUTLET BOXES
- |    |                            |                  |
|----|----------------------------|------------------|
| 1. | Lighting Boxes (concealed) | No. 40-3/4       |
| 2. | Lighting Boxes (concrete)  | OCR Series       |
| 3. | Lighting Boxes (exposed)   | 4S-3/4 or 40-3/4 |

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- |    |   |   |
|----|---|---|
| 4. | Flush Switches, Receptacles<br>Telecommunications and Flush<br>Junction Boxes   | No. 4S-3/4 with separate<br>extension plaster ring; M*-250<br>in masonry construction (* refers<br>to number of devices in the box) |
| 5. | Weatherproof type Switch,<br>Receptacle and Telecommunications<br>Boxes (exposed) and <b>all devices installed<br/>within the BSL3/ABSL3 Area</b> | FD Series w/FD cover and<br>neoprene gasket.  |
| 6. | Switch, Receptacle and<br>Telecommunications Boxes (exposed)  | 4S-3/4 with 8360 or 8370<br>series raised surface cover.  |

- B. Extension and plaster rings shall be installed as required by the NEC.
- C. Outlet boxes shall comply with the National Electrical Code in regard to the allowable fill.

2.5 PULL BOXES

- A. Pull boxes shall be fabricated of code gauge galvanized sheet metal and shall be sized in accordance with the National Electrical Code requirements or as shown on the drawings. Provide removable cover on the largest access side of the box. In-line conduit pull boxes may be O.Z., Type PBW, or equal. Provide pull boxes at all code required locations, and as needed to aid in cable pulling.

2.6 SAFETY SWITCHES

- A. Furnish and install heavy duty type safety switches, having the electrical characteristics, ratings and modifications shown on the drawings. All switches shall have:
- B. NEMA 1 general purpose enclosures unless otherwise noted for all interior applications;
- C. NEMA 3R rainproof enclosures unless otherwise noted for all exterior applications;
- D. NEMA 4/4X stainless steel enclosures unless otherwise noted in all rooms containing autoclave sterilizers and in all BSL3/ABSL3 areas.**
- E. Fully rated neutral assemblies;
- F. Equipment grounding kits;
- G. Metal nameplates, front cover mounted that contain a permanent record of switch type, catalog number and H.P. ratings with both standard and time delay fuses;



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- H. Handle that is padlockable in "OFF" position;
- I. Non-teasible, positive quick-make, quick-break mechanism;
- J. UL approval and shall bear the UL label;
- K. All fusible switches shall have Class R Fuse rejection clips.
- L. Safety switches, as manufactured by the following, will be equally acceptable, but all safety switches furnished by this Contractor shall be the product of one manufacturer:
  - 1. Square D Company
  - 2. General Electric
  - 3. Cutler Hammer
  - 4. Siemens

## 2.7 FUSES

- A. Fuses shall be furnished and installed in each fused switch, and shall be rated as shown on the drawings.
- B. Provide fuses according to the following and in accordance with recommendations of manufacturers whose equipment is being protected:
  - 1. Provide UL Class L current limiting time-delay fuses rated 600-volts, 60 Hz, 601 to 6000 amps, with 200,000A RMS symmetrical interrupting current rating for protecting transformers, motors and circuit breakers. (Similar to Buss Low-Peak fuses.)
  - 2. Provide UL Class L current limiting fast-acting fuses rated 600-volts, 60 Hz, 601 to 6000 amps, with 200,000A RMS symmetrical interrupting current rating for protecting service entrances and main feeder circuit breakers. (Similar to Buss Limitron fuses.)
  - 3. Provide UL Class RK1 current limiting, dual-element, time-delay fuses rated 600-volts, 60 Hz, 1/10 to 600 amps, with 200,000A RMS symmetrical interrupting current rating for protecting motors and circuit breakers. (Similar to Buss Low-Peak fuses.)
  - 4. Provide UL Class RK1 current-limiting fuses rated 250-volts, 60 Hz, 1/10 to 600 amps, with 200,000A RMS symmetrical interrupting current for protecting motors and circuit breakers. (Similar to Buss Low-Peak fuses.)
  - 5. Provide UL Class J current-limiting fuses rated 600-volts, 60 Hz, 1 to 600 amps, with 200,000A RMS symmetrical interrupting current rating for protecting circuits with no heavy inrush current where reduced dimension devices are required.
  - 6. Provide UL Class H fuses rated 600-volts, 60 Hz, 1/10 to 600 amps, with 10,000A RMS symmetrical interrupting current rating for protecting general purpose light duty feeders.
  - 7. Provide UL Class T fuses rated 600-volts, 60 Hz, 1 to 1,200 amps, with 200,000A RMS symmetrical interrupting current rating for protection of non-motor loads where reduced dimension devices are required.

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- C. Three spare fuses shall be furnished for each size and type used. Each fused switch shall be provided with a mastic backed label clearly identifying the type and size of fuse required.

### 3. EXECUTION

#### 3.1 PRODUCT INSTALLATION, GENERAL

- A. Except where more stringent requirements are indicated, comply with product manufacturer's installation instructions and recommendations, including handling, anchorage, assembly, connections, cleaning and testing.

#### 3.2 MOUNTING HEIGHTS

- A. Mounting heights to the center of the box above finished floor for the items listed below shall be as follows, unless otherwise shown. All other device mounting heights shall be as shown on the drawings. All devices shall be mounted in accordance with ADA (Americans with Disabilities Act) requirements.
- B. Flush tumbler switches and lighting controls 46"
- C. Switches in concrete block 46"
- D. Convenience outlets 18" mounted vertically with ground  
prong slot at bottom
- E. Safety switches 54"
- F. Motor controllers 54"
- G. Panelboards to top 72"
- H. Telecommunications outlets 18"
- I. Telecommunications outlets 54" for non-ADA type  
(pay and wall type) 44" for ADA type
- J. Receptacles above counters 8" above counters mounted  
vertically
- K. Convenience outlets in 48"  
mechanical, electrical, telecommunications, janitor  
and elevator machine rooms
- L. Exterior W.P. convenience 24" above grade mounted

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outlets

- |    |   |     |
|----|---|-----|
| M. | Fire alarm pull station   | 46" |
| N. | Fire alarm horn, speaker, bell chime<br>And/or strobe                           | 84" |
| O. | Intercom System Pushbutton<br>Stations  | 46" |
| P. | Card Readers  | 46" |
| Q. | Contractor shall check all equipment layouts and verify exact mounting heights. |     |

3.3 CUTTING AND PATCHING FLOORS, WALLS OR CEILINGS

- A. Cutting, patching, repairing, and finishing of carpentry work, metal work, or concrete work, etc., which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors. Holes required to be cut in floors must be drilled without breaking out around the holes. Cutting, patching, and painting shall conform to the requirements of the General Conditions section of this Specification.
- B. Cutting of structural framing, walls, floors, decks, or other members intended to withstand stress is not permitted.
- C. Sleeves through floors or walls shall be black iron pipe and shall be flush with finished faces of floors, walls or ceilings. Sleeves shall be sized to accommodate raceways indicated.
- D. Use care in piercing water proofing. After the part piercing the waterproofing has been set in place, seal openings, and make absolutely watertight.

3.4 SLEEVES

- A. Sleeves shall be used to accommodate conduit or tubing where conduit or tubing pass through newly poured concrete walls or slabs.
- B. All sleeves through floors and walls shall be black iron pipe, flush with walls or finished floors; and of sizes to accommodate the raceways shown. Sleeves through outside walls above grade shall be caulked with approved caulking compound. Sleeves shall not be required through on grade slabs.
- C. For raceways which enter buildings below grade, install manufactured floor and thruwall seals, similar to Type "FSK" or "WSK" as manufactured by O.Z. Electric Manufacturing Co.

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- D. For raceways that penetrate into the BSL3/ABSL3 area, provide gas-tight and water-tight penetrations to maintain the integrity of the environment.**

3.5 INSTALLATION METHODS

- A. Conductors shall be installed in concealed raceways except as shown otherwise on the drawings or specified to be otherwise in these specifications. Exposed conduits and wires shall be installed parallel or perpendicular to building surfaces. Conduits and wires in the space above ceilings shall be supported adequately and shall not be laid on the top of ceiling systems. Conduits and wires installed above ceilings shall be considered exposed.
- B. Electrical conduits shall not be hung on hangers with any other service foreign to the electrical systems, nor shall they be attached to other foreign services.
- C. The lighting and power branch circuit conductors shall be installed in separate raceway systems unless specifically shown or noted otherwise.
- D. Equipment Bases. Provide concrete equipment bases for all floor mounted equipment furnished under this contract. Concrete bases shall be 3-1/2"-inches high unless noted otherwise and shall extend 3-inches beyond all sides of the unit. Trowel all edges at a 45 degree angle. This work shall be done in accordance with Division 3 of the specifications by the Division 26 Contractor. Bases shall be provided for switchboards, motor control centers, transformers and all other floor mounted equipment.
- E. Outlet Box Locations. Outlet boxes shall be located so they are not placed back-to-back in the same wall, and in metal stud walls, are separated by at least one stud space in order to limit sound transmission from room to room. Outlet boxes installed on opposite sides of fire rated walls shall be spaced at least 24" apart.

3.6 WIRING - NUMBER OF WIRES REQUIRED

- A. The number of wires for lighting and receptacle branch circuits is shown on the drawings. The number of wires in any circuit is determined in accordance with the National Electrical Code, and wiring is provided to perform all functions of the devices being installed. Additionally, wires shall be provided as required by the contract documents, i.e. equipment grounds, etc. Provide the number of wires required for a complete and workable system.

3.7 PROTECTION FROM WEATHER

- A. Raceway stub ups shall be capped or otherwise protected from moisture and debris until such time that the conductors are pulled. Conductors shall not be installed in raceways until the building is protected from the weather, all concrete and plastering is completed, and raceways in which moisture has collected have been swabbed or blown out.

3.8 ELECTRICAL ROOM COORDINATION

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- A. Where a number of electrical panels and/or related electrical items are shown, the Electrical Contractor shall coordinate the physical sizes with his equipment suppliers to ensure that there is adequate space for the items shown to be installed in those areas and that all Code required clearances are maintained.
- B. The Contractor shall rearrange the equipment layout to achieve full use of the available space prior to installing conduit stub ups. Where a conflict or rearrangement exists, the Contractor shall submit a proposed revised layout of the area to the Engineer.

### 3.9 NAMEPLATES

- A. Nameplates shall be provided for all items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards and motor control centers, control devices and other significant equipment
- B. Nameplates shall be 1"x 2-1/2" laminated black phenolic resin with a white core with engraved lettering, a minimum of 3/16-inch high. Manufacturers factory installed nameplates shall be acceptable provided all information is furnished.
- C. Nameplates shall identify the equipment item that the device is serving and also from where the device is being fed from. Nameplates shall also identify the system voltage of the item of equipment.
- D. Nameplates shall also be provided listing calculated SCCR at the main service distribution equipment and elevator controllers in accordance with NEC requirements.

### 3.10 RACEWAY SUPPORTS

- A. Raceways shall be securely supported and fastened in place with pipe straps, wall brackets, caddy clips, hangers or trapeze hangers at intervals specified in Section 26 05 33 "RACEWAYS" or:
  - 1. As shown on the drawings.
  - 2. As may be required by special adverse field conditions.
- B. Spring tension clamps on building steel work may be used only by special permission.
- C. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws or welded threaded studs on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine wood screws. Threaded C-clamps shall not be used. Raceways or pipe straps shall not be welded to steel structures. Holes cut in reinforced concrete beams or in concrete joists shall

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avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used, and bar hangers may be attached with saddle ties of not less than No. 16 AWG double strand zinc-coated steel wire. No raceway shall be attached to the suspended ceiling construction. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts and insulating bushings.

### 3.11 BOX SUPPORTS

- A. Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Plastic expansion shields shall not be used. Threaded studs driven in by powder charge and provided with lockwashers and nuts may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Raceways shall be supported with an approved type fastener not more than 24-inches from the box. Penetration into reinforced concrete beams and into reinforced-concrete joists shall avoid cutting any main reinforcing steel.

### 3.12 LIGHTING FIXTURE SUPPORTS

- A. Lighting fixtures shall be supported as follows and in accordance with all applicable Codes and Regulations:
1. By fixture studs or other devices securely attached to outlet box, or;
  2. By special hangers designed and intended for use as lighting fixture supports, or;
  3. By a special clip or device attached to the ceiling system grid designed to secure the lighting fixture in place or;
  4. By other methods and devices designed and intended for use as lighting fixture support, or;
  5. As shown on the drawings.
  6. All lighting fixtures installed in grid type suspended ceiling systems, shall be positively attached to the ceiling system with clips that are UL listed for the application. In addition, a minimum of four (4) ceiling support system rods or wires shall be provided for each light fixture and shall be installed not more than six (6) inches from fixture corners. Provide two (2) No. 9 gage hangers from each fixture housing to the building structure above (wires may be installed slack). Light fixtures that weigh more than 56 pounds shall be supported directly from the structure above by UL listed and approved hangers. Light fixtures that are smaller than the ceiling grid shall be installed at locations indicated on the reflected ceiling plans, or shall be installed in the center of the ceiling panel and shall be supported independently by at least two metal channels that span and are secured to the ceiling system.
  7. Suspended lighting fixtures shall be supported directly from the building structure without using suspended ceilings as support systems. Support systems shall be UL listed and approved for the specific installation. Where pendants or rods exceed 48 inches in length, brace support systems to limit swinging.

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- B. The lighting fixture support system detail shall be submitted with and be a part of the lighting fixture shop drawing submittal.
  
- C. Lighting fixtures shall not be supported from the leg of pre-cast pre-stressed concrete.

END OF SECTION 26 05 01

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## **SECTION 26 05 19 - CONDUCTORS**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this Section.
- B. This Section is a Division 26 "Basic Materials and Methods" section, and is part of each Division 26 section making reference to conductors.

#### **1.2 Description of Work:** Extent of electrical wire and electrical cable work is indicated by drawings and schedules. Types of wire, cable and connectors in this Section include the following:

- A. Conductors
- B. Power-limited circuit cable

#### **1.3 QUALITY ASSURANCE**

- A. **Manufacturers:** Firms regularly engaged in the manufacture of electric wire and cable products of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Installer:** Qualified with at least 3 years of successful installation experience on projects with electrical wiring work similar to that required for this project.

#### **1.4 REFERENCES**

- A. **NEC Compliance:** Comply with NEC as applicable to construction and installation of electrical wire, cable and connectors.
- B. **UL Compliance:** Comply with UL standards pertaining to wire cable and connectors.
- C. **UL Labels:** Provide electrical wires, cables and connectors which have been UL-listed and labeled.
- D. **NEMA/ICEA Compliance:** Comply with applicable portions of NEMA/Insulated Cable Engineers Association Standards pertaining to materials, construction and testing of wire and cable.
- E. **ANSI/ASTM:** Comply with applicable portions of ANSI/ASTM standards pertaining to construction of wire and cable.



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- F. IEEE Compliance: Comply with applicable portions of IEEE standards pertaining to wire and cable.
- G. NECA Compliance: Comply with NECA's "Standard of Installation."

1.5 SUBMITTALS

- A. Submit manufacturer's data on electric wire and cable.

**2. PRODUCTS**

2.1 Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable and connector):

A. WIRE AND CABLE:

1. Advance Wire and Cable, Inc.
2. Cerro Wire and Cable, Co.
3. Electrical Conductors, Inc.
4. General Cable Corp.
5. Hitemp Wires, Inc.
6. Rome Cable Corp.
7. Southwire Company
8. The Okonite Company
9. Encore Wire

B. CONNECTORS:

1. Amp, Inc.
2. Burndy Corp.
3. Eagle Electric Mfg. Co., Inc.
4. Gould, Inc.
5. Ideal Industries, Inc.
6. Joselyn Mfg. and Supply Co.
7. O-Z/Gedney Co.
8. Pyle National Co.
9. Thomas and Betts Co.

2.2 WIRE, CABLE, AND CONNECTORS

- A. General: Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation.
- B. WIRE:

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1. All conductors shall be 600-volt and shall be copper, soft drawn, annealed, having a conductivity of not less than 98% pure copper with dual rated type THHN/THWN insulation unless otherwise specified or indicated on the drawings.
2. No wire shall be smaller than No. 12 AWG, except wiring for signal and pilot control circuits, and pre-manufactured fixture whips for light fixtures.
3. All wire No. 12 AWG shall be solid unless otherwise indicated within these specifications. All wire No. 10 AWG and larger shall be stranded.
4. All wiring installed in light poles or other areas subject to vibration shall be stranded.
5. Wire sizes shown are minimum based on code requirements, voltage drop and/or other considerations. Larger sizes may be installed at the Contractor's option to utilize stock size, provided conduit sizes are increased where necessary to conform to the National Electrical Code. Sizes of wires and cables indicated or specified are American Wire Gage (Brown and Sharpe).
6. All feeder and branch circuit wiring shall be color-coded as follows:

<u>PHASE</u>	<u>120/208 VOLT</u>	<u>277/480 VOLT</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	*White	*White
Ground	Green	Green

\*Except as provided in paragraph 200.6 of the NEC.

C. ALUMINUM WIRE:

1. Aluminum conductors shall not be substituted for copper conductors.

D. CONNECTIONS

1. Wire connections shall be as follows unless otherwise indicated on the drawings.
  - a. Use preinsulated connectors 3M Company "Scotchlok," or Ideal Industries, Inc. "super nut," for splices and taps in conductors No. 10 AWG and smaller. All other twist-on connectors must be reviewed by the Architect prior to installation. Use this type of connector for factory-made splices in fixtures or equipment.
  - b. Pressure indent type connectors must be submitted to the Architect for review.
  - c. Tape all splices and joints with vinyl plastic tape manufactured by Minnesota Mining and Manufacturing Company. Use sufficient tape to secure insulation strength equal to that of the conductors joined.
  - d. Keep splices in underground junction boxes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company, St. Paul, Minnesota, to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
  - e. Connect wire No. 6 AWG and larger to panels and apparatus by means of approved lugs or connectors.

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- f. Connect wire No. 10 AWG and larger to panels, motors and electrical apparatus using OZ (or equivalent) type XL set screw type lugs. Lugs shall accommodate full wire capacity for stranded conductors. All connections and connectors shall be solderless.
- g. Connectors of the porcelain cup type with or without metal inserts shall not be used, including all splices in fixtures which are made in advance by the fixture manufacturer. Splices in wire No. 8 AWG and larger shall be made with approved solderless lugs. If any type of pressure indent type connector is proposed for use on any size conductor, it shall be specifically submitted for approval prior to use.

### 3. EXECUTION

#### 3.1 INSTALLATION

- A. General: Install electric cables, wires and connectors as indicated in compliance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized wherever required.
- D. Splicing: No splicing or joints will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes.
- E. Wire shall not be installed in raceways until the concrete work and plastering is completed and all conduits in which moisture has collected have been swabbed out. Insulation resistance to ground shall not be less than that approved by NEC. Eliminate splices wherever possible.
- F. Use pulling compound or lubricant where necessary. Compound must not deteriorate conductor insulation.
- G. Prior to energization, check cable and wire for continuity of circuitry, and for short circuits. Correct malfunctions when detected.
- H. Bury a continuous, pre-printed, bright colored plastic ribbon cable marker with each underground cable, regardless of whether conductors are in conduit. Locate each directly over cables 12" below finished grade.
- I. Conductor Installation: Install all conductors in a single raceway at one time, insuring that conductors do not cross one another while being pulled into raceway. Leave sufficient cable at all fittings or boxes and prevent conductor kinks. Keep all conductors within the allowable tension and exceeding the minimum bending radius.

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- J. Conductor Support: Provide conductor supports as required by the code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Type C.M.T., and provide the lower end of conduit with OZ Type KVF ventilators.
- K. Conductor Termination: Provide all power and control conductors, that terminate on equipment or terminal strips, with solderless lugs or fork and flanged tongue terminals. Provide T and B "sta-kon" tongue terminal. This type conductor termination is not required when the equipment is provided with solderless connectors.
- L. **Many circuits are shown on the drawings to be provided with dedicated neutral and ground conductors. Carefully review circuiting and the electrical abbreviations and symbols legend and provide the number of conductors indicated.**
- M. **Unless otherwise indicated provide dedicated neutral conductors for all branch circuits. Neutral conductors shall not be shared between circuits. Where the drawings indicate shared neutral conductors, for a multi-wire branch circuit, group the breakers together in accordance with NEC requirements.**

### 3.2 CONDUCTOR ARCPROOFING

- A. Cover two or more power feeder cables occurring in the same switchboard section, junction box or pull box (including pull boxes over switchboards) with arcproof and flameproof tape.
- B. Provide 3M Company "Scotch" No. 77 tape or Plymouth Rubber Co. Slipknot No. 30 tape, to provide an installation capable of withstanding a 200-amp arc for not less than 30 seconds.
- C. Apply tape in a single layer, one-half lapped, or as recommended by the manufacturer to conform to the above requirements. Apply with the coated side next to the cable and hold in place with a random wrap of 1/2 inch wide, pressure-sensitive, glass cloth electrical tape, 3M Company "Scotch" No. 69. Tape to be color coded as specified previously.

END OF SECTION 26 05 19

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## **SECTION 26 05 26 - GROUNDING SYSTEM**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this Section.
- B. Division 26 "Basic Materials and Methods" sections apply to work of this Section.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of grounding work is indicated by the drawings and is specified herein.
- B. Applications of grounding work in this Section include the following:
  - 1. Underground Metal Piping
  - 2. Underground Metal Water Piping
  - 3. Metal Building Frames
  - 4. Ground Rods
  - 5. Separately Derived Systems
  - 6. Enclosures
  - 7. Equipment
- C. Requirements of this Section apply to electrical grounding work specified elsewhere in these specifications.

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been of satisfactory use in similar service for not less than three years.
- B. Installer: Qualified with at least three (3) years experience on projects with electrical grounding work similar to that required for this project.

#### **1.4 REFERENCES**

- A. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.

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- B. UL Compliance: Comply with applicable requirements of UL Standard Nos. 467 and 869 pertaining to electrical grounding and bonding.
- C. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.
- D. Utility: Grounding shall be done so as to comply with all applicable grounding requirements and rules of the serving utility.
- E. NECA Compliance: Comply with NECA's "Standard of Installation."

1.5 SUBMITTALS

- A. Product Data: Submit manufacturers data on grounding systems and accessories.
- B. Shop Drawings: Submit layout drawings of grounding systems and accessories including, but not limited to, ground wiring, copper braid and bus, and ground rods.

**2. PRODUCTS**

2.1 Acceptable Manufacturers: Subject to compliance with the requirements, provide grounding products of one of the following:

- A. B-Line Systems
- B. Burndy Corporation
- C. Crouse Hinds
- D. Electrical Components Div.; Gould Inc.
- E. General Electric Supply Co.
- F. Ideal Industries, Inc.
- G. Thomas and Betts Corp.
- H. Western Electric Co.

2.2 Grounding Systems: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including but not limited to cables/wires, connectors, terminals, ground rods/electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where more than one type unit meets indicated requirements, selection

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is installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards for applications indicated.

- 2.3 Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC requirements.
- 2.4 Bonding Jumper Braid: Provide copper braid tape, constructed of 30 gage bare copper wires and properly sized for indicated applications.
- 2.5 Flexible Jumper Strap: Provide flexible flat conductor, 480 strands of 30 gage bare copper wire; 3/4" wide, 9-1/2" long; 48,250 cmil. Protect braid with copper bolt hole ends with hole sized for 3/8" dia. bolts.
- 2.6 Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for indicated applications.
- 2.7 Ground Rods: Provide steel ground rods with copper welded exterior, 3/4" dia. x 10'.
- 2.8 Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by accessories manufacturers for types of service indicated.

### 3. EXECUTION

#### 3.1 GENERAL

- A. Inspection: Installer must examine areas and conditions under which electrical grounding connections are to be made and notify the Architect/Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. General: Install electrical ground systems where shown, in accordance with applicable portions of the NEC, with NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- C. Coordinate with other electrical work as necessary to interface installation of electrical grounding systems with other work.
- D. Grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded shall be accomplished for temporary and permanent construction.
- E. Provide a separate green equipment ground conductor in all electrical raceways to effectively ground all fixtures, panels, receptacles, controls, motors, disconnect switches, exterior lighting



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standards and noncurrent carrying metal enclosures. The ground wires shall be connected to the building system ground. NEC Table 250-95 shall be used to size the ground conductor if the size is not shown on the drawings.

- F. To satisfy the "effective grounding" requirements of the NEC the path to ground from circuits, equipment, and conductor enclosures shall be permanent and continuous and shall have ample carrying capacity to conduct safely any currents liable to be imposed on it, and shall have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the overcurrent devices in the circuit.
- G. Clean the contact surfaces of all ground connections.
- H. Where separately derived systems occur, ground the system to a grounding electrode acceptable to the code.
- I. Install metallic raceways mechanically and electrically secure at all joints and at all boxes, cabinets, fittings and equipment. At the point of electrical service entrance, bond all metallic raceways together, with a ground conductor, and connect to the system ground bus. Bond all boxes as specified for equipment.
- J. Receptacles: Permanently connect the ground terminal on each receptacle to the green ground conductor.
- K. Motors: Connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted, solderless lug.

END OF SECTION 26 05 26

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## **SECTION 26 05 33 - RACEWAYS**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this Section.
- B. This Section is a Division 26 "Basic Materials and Methods" section, and is part of each Division 26 section making reference to electrical raceways specified herein.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of raceways is indicated by drawings and schedules.
- B. Types of raceways in this Section include the following:
  - 1. Electrical metallic tubing.
  - 2. Flexible metal conduit.
  - 3. Intermediate metal conduit.
  - 4. Liquid-tight flexible metal conduit.
  - 5. Rigid metal conduit.
  - 6. Rigid nonmetallic conduit.

#### **1.3 REFERENCES**

- A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL-listed and labeled. Each length of raceway shall bear the Underwriters Laboratories label.
- C. NEC Compliance: Comply with NEC requirements which are applicable to the construction and installation of raceway systems.
- D. NECA Compliance: Comply with NECA's "Standard of Installation".
- E. NIH DRM: Comply with raceway installation requirements.

#### **1.4 SUBMITTALS**

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- A. **Product Data:** Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of raceway required.

## 2. PRODUCTS

### 2.1 STEEL CONDUIT

- A. **Steel Conduit:** Rigid steel conduit, intermediate metal conduit and steel electrical metallic tubing shall be hot-dipped, galvanized or sheradized as manufactured by Youngstown Sheet and Tube Company, National Electric, General Electric, or equal.
- B. **Joints:** Raintight non-insulated throat type compression fittings (connectors and couplings) shall be provided for electrical metallic tubing systems. All fittings shall be of the steel type with steel locknuts equal to Appleton 95 Series.
- C. **Expansion Joints:** Provide expansion fittings, O.Z. Type AX with bonding jumper for rigid conduit and O.Z. Type TX with bonding jumper for electrical metallic tubing. Where embedded raceways cross building expansion joints, provide combination deflection/expansion fittings, O.Z. Type AXDX, or equal.

### 2.2 RIGID NON-METALLIC (PVC) CONDUIT

- A. **PVC (polyvinyl chloride) Conduit:** Heavy wall rigid PVC conduit shall be composed of high impact PVC and shall conform to industry NEMA Standards and to Federal Specification WC-1094. Conduits shall be Carlon Schedule 40 type, or approved equal.

### 2.3 FLEXIBLE METAL CONDUIT

- A. Flexible metal conduit shall conform to UL1. It shall be formed from continuous length of spirally-wound, interlocked zinc-coated strip steel.
- B. **Pre-wired armored cabling, types AC or MC are not allowed.**

### 2.4 LIQUID-TIGHT, FLEXIBLE METAL CONDUIT

- A. Liquid-tight flexible metal conduit shall be constructed of a single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; and coated with an oil-resistant, liquid-tight thermoplastic jacket.

### 2.5 WIREWAYS

- A. **General:** Provide electrical wireways of types, grades, sizes, weights (wall thicknesses), and number of channels for each type service indicated. Provide complete assembly of wireways including, but not necessarily limited to couplings, offsets, elbows, expansion joints, adapters,

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hold down straps, end caps, and other components and accessories as needed for a complete system. Where types and grades are not indicated, provide proper selection as determined by the Installer to fulfill wiring requirements and comply with applicable provisions of NEC for electrical raceways.

B. Manufacturers: Subject to compliance with requirements, provide surface metal raceways of one of the following:

1. B-Line Systems, Inc.
2. Midland-Ross Corporation
3. Power-Strut Division; Youngstown Sheet and Tube Company
4. Square D Company
5. Versa-Tech Corporation
6. Walker/Parkersburg Division; Textron, Inc.
7. Wiremold Company

### 3. EXECUTION

#### 3.1 GENERAL

- A. Install electric raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation" and complying with recognized industry practices.
- B. Raceways embedded in concrete or in earth below floor slabs shall be rigid steel conduit, intermediate metal conduit or rigid schedule 40 PVC conduit. Rigid PVC conduit shall be provided with rigid metal or intermediate metal conduit elbows when the raceway system exits the concrete topping or earth.
- C. Electrical metallic tubing shall not be embedded in concrete or installed in earth.
- D. Rigid heavy wall Schedule 40 PVC conduit shall be installed in earth and concrete only.
- E. Raceways in outside walls (excluding building perimeter) or in refrigerated areas shall be rigid steel conduit, or intermediate metal conduit.
- F. Provide rigid steel conduit or intermediate metal conduit for exposed raceways from floor to eight feet above the floor in mechanical rooms and in areas designated on the plans.
- G. Rigid galvanized steel conduit or galvanized intermediate metal conduit shall be used where conduit is exposed to weather.
- H. **Rigid galvanized steel and cast boxes with external hubs shall be used to serve electrical devices located within the Bio Safety Level 3 (BSL3) and Animal Bio Safety Level 3 (ABSL3) barrier.**

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- I. Conduits in hazardous locations shall conform to the National Electrical Code. Rigid galvanized steel conduit or intermediate metal conduit shall be used in hazardous locations. PVC conduit shall not be used in hazardous areas.
- J. Rigid metal, intermediate metal, electric metallic tubing or PVC conduit where allowed in other section 3.1 paragraphs shall be used for feeders and branch circuits.
- K. Flexible metal conduit may be used to connect light fixtures in accordance with NEC requirements but must be limited to a maximum of 6'-0" in length. "Daisy chaining" from fixture to fixture is not permitted. Provide flexible metal conduit for connections to motors, transformers, generators, and other equipment subject to vibration. Length of flexible conduit shall be a minimum of one foot for conduit diameters up to 1-1/2". A minimum of 3" of flexible conduit shall be added for every 1/2" increase in conduit diameter. Flexible metal conduit installation shall be kept to a minimum in connecting other electrical equipment items. Sealtight, flexible conduit shall be used where the flexible conduit may be subject to moist or humid atmosphere, corrosive atmosphere, subject to water spray and subject to dripping oil, grease or water. **Flexible metal conduits shall not be permitted for any other applications, unless specifically approved by the Owner**
- L. Conduits shall be 3/4" diameter, minimum. Raceway sizes shown on the drawing are based on type THHN/THWN conductors.
- M. Type Material: Except as noted otherwise all conduit shall be steel.

### 3.2 INSTALLATION

- A. All raceways shall be installed concealed except where shown or noted otherwise.
- B. At the Owner's option, concealed raceways may be embedded in concrete or routed below the slab. At the Contractor's option, concealed raceways may be installed in furred spaces above ceilings or behind walls.
- C. Continuity: Provide metallic raceways continuous from outlet to outlet, and from outlets to cabinets, junction or pull boxes. Enter and secure conduit to all boxes to provide electrical continuity from the point of service to outlets. Provide double locknut and bushing on terminals of metallic conduits.
- D. A nylon or polypropylene pull string shall be installed in all empty conduits to facilitate future installation of cabling.
- E. Provide accessible "seal-off" fittings for all raceways entering or leaving the **BSL3/ABSL3 barrier**, hazardous areas, and as otherwise required by the National Electrical Code.

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- F. Where conduits penetrate the roof seal, they shall be installed in curbs provided for mechanical equipment. When this is not possible, suitable pitch pockets, lead flashing, or approved fittings shall be provided. Details for special conduit installations shall be as shown on the drawings.
- G. Reinforced Concrete: No reinforcing steel shall be displaced to accommodate the installation of raceways and outlet boxes. Outlet boxes shall not be installed in beams or joists. In general, all embedded conduits shall be located in the physical center of the particular section of concrete. Unless otherwise indicated, raceways embedded in reinforced concrete shall conform to the following usual types of conditions. Particular attention is called to the fact that there are many extenuating conditions where the Contractor may be instructed in writing during the course of the project not to place embedded conduits in certain areas, generally due to the possibility of unsightly cracking or for structural reasons. This instruction shall not entitle the Contractor to extra compensation. Any condition not covered by the following usual conditions shall require special clarification.

Location

Maximum Allowance

- |                                  |  |
|----------------------------------|--|
| 1. Columns                       | Displacement of 4 percent of plan area of column.  |
| 2. Floors and Walls              | Displacement of 1/3 of thickness of concrete spaced not less than three diameters on center. |
| 3. Beams and Joists              | Displacement of 1/3 of least dimension, spaced not less than three diameters on center.      |
| 4. Sleeves thru Floors and Walls | 2" maximum pipe size, not less than three diameters on center.                               |
- H. Plain Concrete: Raceways shall not be placed in plain concrete, such as cement toppings on structural floors without special instructions.
- I. Furred Spaces: Raceways installed in furred spaces shall be installed in accordance with the requirements of the National Electrical Code. Do not anchor or strap conduits to the ceiling furring channels or attach to furred ceiling hanger wires. Raceways may be attached to the suspension system (wire hangers) of drop ceilings if installed in such a manner that the ceiling panels may be removed without interference with the raceway, and the wire hangers are sized to carry the additional raceway load.
- J. Stub Ups: Extend conduit stubs at least one foot above slab or fill, before connection is made to electrical metallic tubing.
- K. Exterior Conduits: Install raceways a minimum of 42" below finished grade unless noted otherwise on the drawings.
- L. Provide marking of conduit and junction boxes to indicate which distribution system they are serving. The markings could be colored tape on conduit at or near junction boxes with different colored tapes indicating different distribution systems. Concealed junction boxes shall be

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legibly marked with a magic marker to indicate the panel and circuit number that junction box serves.

1. The distribution systems shall be color coded as follows:

- a. Fire Alarm - Red
- b. Paging System - Blue
- c. 120/208 Volt - Green
- d. 277/480 Volt - Orange
- e. Cable TV System - Black
- f. Telephone System - White

M. Steel Conduit (galvanized rigid steel, IMC or EMT):

1. Cutting: Cutting shall be done with hand or power hacksaws. All cut ends shall be reamed to remove burrs and sharp edges.
2. All threaded joints shall be made up wrench-tight and all compression joints shall be made up mechanically secure and snug so as to make continuous current-carrying electrical contact.
3. All metallic conduits buried or otherwise in contact with earth shall be painted using one heavy continuous coat of asphalt varnish after assembly of conduit and fittings.
4. Expansion joints shall be installed in steel conduit systems in structures as follows (expansion joints are specified elsewhere in the specification):
  - a. Where conduit run crosses a building expansion joint.
  - b. In any conduit run exceeding 100 feet in length.
  - c. Where shown on the drawings.

N. Threads: Clean all threads of rigid or intermediate metal conduit. Coat all male threads of all steel conduit installed in concrete with red or white lead immediately before being coupled together.

O. Running Threads: Use "Erickson" type couplings in lieu of running threads.

P. PVC Conduit:

1. Joints: Conduits shall be joined by using couplings and solvent cement furnished or recommended by the raceway manufacturer. Finished joints shall be secure and watertight.
2. Cutting: Cutting shall be done with hacksaws and ends shall be reamed to remove burrs and sharp edges.
3. Expansion Joints: Expansion joints shall be installed:
  - a. Where conduit run crosses a building expansion joint.
  - b. As recommended by the manufacturer or as shown on the drawings.

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4. Bends for PVC conduit sizes 2" and smaller may be made "hot" in the field. Inside dimension shall be thereby undistorted. For PVC sizes larger than 2", provide only factory bends.

END OF SECTION 26 05 33



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## **SECTION 260800 - ELECTRICAL COMMISSIONING REQUIREMENTS**

### **PART 1 GENERAL**

#### **1.1 WORK INCLUDES**

- A. Validation of proper installation of Divisions 26 systems and equipment
- B. Systems and equipment testing and startup
- C. Equipment performance verification
- D. Functional testing of control systems
- E. Documentation of tests, procedures and installations

#### **1.2 SCOPE INCLUDES**

- A. Systems to be commissioned include the following:
  - 1. Power Distribution [Panelboards and Transformers]
  - 2. Emergency Power

#### **1.3 RELATED DOCUMENTS**

- A. Commissioning Plan - This plan is part of the Contract Documents and outlines many responsibilities, procedures and tasks throughout the commissioning process.
- B. Section 019113 – General Commissioning Requirements
- C. Section 230800 – Mechanical Commissioning Requirements
- D. Division 26 Sections - Individual Sections stipulate installation, startup, warranty and training requirements for the system or device specified in that Section.

#### **1.4 REFERENCES**

- A. ASHRAE Guideline 0-2013: The HVAC Commissioning Process.
- B. ANSI/NEBB S110-2019 - Whole Building Technical Commissioning of New Construction

#### **1.5 GENERAL DESCRIPTION**

- A. Commissioning is a process to assure all building systems are installed and perform interactively according to the design intent; the systems are efficient, cost effective and meet the Owner's operational needs; the installation is adequately documented. Commissioning

serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance building systems from installation to fully optimized operation.

- B. The Commissioning Authority will work with the Contractor and Design Engineer to coordinate, oversee, and document the commissioning process during the Construction Phase of this project.
- C. This Section defines responsibilities of the Contractor to facilitate the commissioning process particularly during the Construction Phase of the project.

## 1.6 DEFINITIONS

- A. Refer to specification section 019113 for definitions related to the commissioning process.

## 1.7 DOCUMENTATION

- A. Contractor shall send Commissioning Authority one copy of the following per the procedures specified in other sections of the Specification:
  - 1. Shop drawings and product data related to systems and equipment to be commissioned on this project. CxA will review and incorporate comments via the Design Engineer.
  - 2. Initial draft of equipment startup plan checklists along with manufacturers' startup procedures. CxA will assist in development and recommend approval.
  - 3. System Test Reports. CxA will review and compile prior to FPT.
  - 4. System certificate of readiness including completed equipment startup forms along with the manufacturers' field or factory performance test documentation. CxA will review and approve prior to FPT.

## 1.8 SEQUENCING AND SCHEDULING

- A. Systems can be in various stages of the commissioning process where appropriate, in order to expedite close out of the facility. The CxA and Contractor shall cooperate to schedule Cx tasks to minimize the duration of Cx activities. Sequential priorities shall be followed per the Cx Plan.
- B. Commissioning Schedule - Contractor shall incorporate the commissioning process into the project schedule. Startup, TAB and FPT shall be itemized as applicable for each system. Durations for each task shall be coordinated with the CxA.

## 1.9 COORDINATION MANAGEMENT PROTOCOLS

- A. Coordination responsibilities and management protocols relative to Cx are initially defined in the Cx Plan but will be refined and documented at the commissioning scoping meeting. Contractor shall have input to the protocols and all parties will commit to scheduling obligations. The CxA will record and distribute notes from the meeting.

## 1.10 CONTRACTOR RESPONSIBILITIES

### A. Construction Phase

1. Include commissioning requirements in price and plan for work.
2. Attend scoping and coordination meetings scheduled by the CxA.
3. Remedy deficiencies identified during the construction period.
4. Prepare and submit required draft forms and equipment information requested by the CxA. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the CxA.
5. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
6. Provide limited assistance to the CxA in preparing the specific functional performance test procedures. Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Where functional testing is to be executed by the system/equipment provider (see "Systems/Equipment to be Commissioned") the Contractor, with the CxA's assistance, will develop final functional test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested.
8. Thoroughly complete and inspect installation of systems and equipment in accordance with the Contract Documents, reference or industry standards, and specifically Part 3 of this Section.
9. Startup systems and equipment prior to verification and performance testing by the CxA. Startup procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part 3 of this Section.
10. Record startup and test procedures on startup forms and checklists and certify the systems and equipment have been started and tested in accordance with the Contract Documents, reference or industry standards, and specifically Part 3 of this Section. Each form shall be signed and dated by the individual responsible for the startup or test.
11. Complete pre-approved startup checklists and submit along with other installation certification documentation such as certificate of readiness, warranties, test results, etc.
12. Schedule and coordinate Cx efforts required by appropriate subcontractors and vendors.
13. Demonstrate the systems as specified.
14. Certify systems have been installed and are operating per Contract Documents through certificates of readiness.
15. Maintain an updated set of record documentation.

16. Copy CxA on indicated documentation.
  17. Conduct equipment operation, maintenance, diagnosis and repair training as required by the respective section of the Specifications.
- B. Acceptance Phase
1. Assist CxA in verification and performance testing. Assistance will generally include the following:
    - a. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
    - b. Manipulate systems and equipment to facilitate testing.
    - c. Manipulate control systems to facilitate verification and performance testing.
  2. Correct any work not in accordance with Contract Documents and non-conformances included in the commissioning issues log.
- C. Warranty Phase
1. Provide warranty service.
  2. Correct any deficiencies identified.
  3. Update record documentation to reflect any changes made throughout the Warranty Phase.

#### 1.11 CONTRACTOR NOTIFICATION

- A. Contractor shall completely install, thoroughly inspect, startup systems and equipment. All activities shall be documented on specified forms. Contractor shall notify Design Engineer, Owner and CxA via the certification of readiness that systems are complete and ready for verification and functional performance testing.
- B. Contractor shall notify CxA at least 10 business days in advance of any tests or startups. CxA shall witness selected tests and startups.

#### 1.12 STARTUP CHECKLISTS

- A. Startup checklists for each type of equipment and system shall be submitted to CxA for approval prior to startup. The forms shall be designed by the appropriate subcontractors or vendors to meet the requirements of the Contract Documents. Forms shall be developed for the specific equipment being installed for this project.
- B. Startup checklists shall generally include the following for each (as applicable):
  1. Project specific designation, location and service
  2. Pertinent nameplate data
  3. Indication of the party performing the test
  4. Field for signature of the startup technician along with the date

5. Clear explanation of the inspection, test, measurement, etc. with a pass/fail indication and a record of measurement parameters
  6. Checklist space that proper maintenance clearances have been maintained
  7. Checklist space indicating that any required special tools and/or spare tools were turned over to the Owner
  8. Checklist space indicating that required prerequisite equipment and systems were successfully started.
- C. Startup checklists shall incorporate the manufacturer-specified procedures. Contractor shall compile the startup and checkout procedures indicated in the manufacturer's documentation prior to designing the forms. Include specified acceptance criteria as applicable. The manufacturer's startup and checkout procedures shall be submitted to the CxA along with the draft startup checklists.
- D. Completed startup plans for all pieces of equipment included in a system shall be submitted to CxA prior to verification and performance testing.
- E. See specification 019113 for additional information regarding Startup Checklists.

#### 1.13 FUNCTIONAL PERFORMANCE TESTING

- A. Participation: CxA will coordinate, test and/or witness functional performance tests after the successful startup and documentation of systems and equipment is complete. Contractor shall assist, as described above, with manipulation of the systems or equipment; provision of supporting equipment or materials (lifts, ladders, specialty test equipment, etc.); and on the spot remediation of minor identified deficiencies.
- B. Detailed Test Forms: CxA will prepare detailed testing procedures and forms to conduct and document the FPT. These will be developed during the Construction Phase and completed during the Acceptance Phase.
- C. Test Documentation: CxA will record test results on the forms developed for the testing. CxA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly indicate when the test has failed. CxA shall recommend acceptance of the system or component after all related testing is successfully complete.
- D. Deficiencies and Retesting: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. Significant deficiencies will fail the test and require retesting of the affected portions of the test. The CxA will subsequently track the resolution of the deficiency via the Project Deficiency List. All tests shall be repeated until successful completion.

#### PART 2 PRODUCTS (Not Used)

#### PART 3 EXECUTION

##### 3.1 GENERAL

- A. This Section outlines specific startup, checkout, and functional testing requirements for systems and equipment. Generally, these procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct. These requirements along with those specified in the individual Section provide a minimum guideline for development of startup procedures, checklists and tests. Contractor shall synthesize these requirements with that of the manufacturer's and/or applicable codes and standards to develop specific and itemized startup procedures specific to that installed on this project.
- B. Refer to all Division 26 Specifications for tests performed on installed equipment and systems.

### 3.2 STARTUP

- A. The contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 019113. The Contractor has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning authority or Owner.
- B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and Contractor. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all startup plan checklists as soon as possible.

### 3.3 STARTUP/CHECKOUT

- A. Verify that equipment testing work is complete before starting functional performance of power equipment.
- B. Inspect equipment and confirm that it is clean and ready for operation. All shipping tags removed, nameplates installed and equipment manuals in place.
- C. Verify all equipment labeling corresponds with drawings and indices and meets required Specifications. Correct any deficiencies for electrical systems.

### 3.4 POWER DISTRIBUTION – STARTUP/CHECKOUT

- A. Overcurrent protective device settings coordinated and adjusted per the study results.
- B. System in place and tested, including all components indicated.
- C. Connected to utility company power system on a permanent basis.
- D. Wiring installed in conduits or other raceways.
- E. System checked for unwanted grounds, short circuits or open circuits.
- F. Ground installed as indicated, including transformers.

- G. Equipment connections properly torqued.
- H. Equipment, where indicated, on housekeeping pads.
- I. Equipment cleaned and shipping blocks removed.
- J. Equipment labeled.
- K. Boxes and nameplates meet color coding requirements.

### 3.5 EMERGENCY POWER DISTRIBUTION – STARTUP/CHECKOUT

- A. System in place and tested, including all components indicated.
- B. Facility shall be connected to utility company power system on a permanent basis before emergency checklist is addressed.
- C. Wiring installed in conduits or other raceways.
- D. System checked for unwanted grounds, short circuits or open circuits.
- E. Grounds installed as indicated, including transformers.
- F. Ground fault settings made.
- G. Equipment connections properly torqued.
- H. Equipment, where indicated, on housekeeping pads.
- I. Equipment cleaned and shipping blocks removed.
- J. All ATS delay and timer settings are programmed.
- K. Equipment labeled.
- L. Boxes and nameplates meet color coding requirements.
- M. Proper phase rotation coordinated between emergency and normal sources

### 3.6 FUNCTIONAL TESTING

- A. This section specifies the functional testing requirements for Division 26 systems and equipment. From these requirements, the Commissioning Authority (CxA) shall develop step-by-step procedures to be executed by the Contractors or the Commissioning Authority. The general functional testing process, requirements and test method definitions are described in Section 019113. The test requirements for each piece of equipment or system contain the following:
  - 1. The contractors responsible to execute the tests, under the direction of the CxA
  - 2. A list of the integral components being tested



3. Startup plan checklists associated with the components
4. Functions and modes to be tested
5. Required conditions of the test for each mode
6. Special procedures
7. Required monitoring
8. Acceptance criteria

**B. PREREQUISITES**

1. The following applicable generic prerequisite checklist items are required to be completed and submitted with the equipment/system certificate of readiness and checked off by CxA prior to functional testing.
2. All related equipment has been started up and startup plan checklists submitted and approved ready for functional testing.
3. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.
4. Test and balance (TAB) complete and approved for the air and hydronic systems
5. All A/E punchlist items for this equipment corrected
6. Schedules and setpoints provided to the CxA
7. False loading equipment, system and procedures ready
8. Sufficient clearance around equipment for servicing

**C. MONITORING**

1. Monitoring is a method of testing as a stand-alone method or to augment manual testing.
2. All points listed in the required monitoring section of the test requirements which are control system monitored points shall be trended by the controls contractor. Other points shall be monitored by the CxA using dataloggers. At the option of the CxA, some control system monitoring may be replaced with datalogger monitoring. At the CxA's request, the controls contractor shall trend up to 20% more points than listed herein at no extra charge.
3. Trend output data must be in an ASCII delimited text file with time continuous down left column and point values in column(s) to the right.
4. All trends for points of a group must start at the same moment in time, unless specifically approved otherwise with the commissioning agent.

**3.7 NORMAL POWER SYSTEMS FPT**

**A. Parties Responsible to Execute Functional Test**

1. Electrical contractor: perform functional testing
2. CxA: to witness, direct and document testing.
3. Equipment manufacturer's representative, as required.

4. Owner's Representative
  5. Owner's maintenance staff, as desired.
- B. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.7.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.
- C. Functions / Modes Required to be Tested
1. Activate system by connection to utility power.
  2. Verify voltages and amperes at meters on switchgear.
  3. Verify voltages and amperes at switchgear, switchboards, motor control centers, panelboards, and transformers, both primary and secondary.
  4. Verify voltages and amperes at mechanical motors and other major pieces of equipment.
- D. Results: If specified equipment performance is not achieved, the Contractor shall have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.
- E. Acceptance Criteria
1. For the conditions, sequences and modes tested, the system, integral components, and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

END OF REQUIREMENTS FOR POWER SYSTEMS TEST

3.8 EMERGENCY POWER SYSTEMS FPT

- A. Parties Responsible to Execute Functional Test
1. Electrical contractor: perform functional testing
  2. CxA: to witness, direct and document testing.
  3. Equipment manufacturer's representative, as required.
  4. Owner's Representative
  5. Owner's maintenance staff, as desired.
- B. Prerequisites: The applicable prerequisite checklist items listed in paragraph 3.5.B shall be listed on each certificate of readiness form and checked off prior to functional testing. The commissioning agent will also spot-check misc. items and calibrations on the startup plan checklists previously completed by the installer, before the beginning of functional testing.
- C. Functions / Modes Required to be Tested
1. Activate system by manual transfer from utility power.
  2. Demonstrate automatic transfer of power.

- D. Results: If specified equipment performance is not achieved, the Contractor shall have corrections made and reschedule Functional Performance Test as soon as possible after corrective work is completed.
- E. Acceptance Criteria
  - 1. For the conditions, sequences and modes tested, the system, integral components, and related equipment respond to varying loads and changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.

END OF REQUIREMENTS FOR EMERGENCY POWER SYSTEMS TEST

END OF SECTION 260800

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## **SECTION 26 27 26 - WIRING DEVICES**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this Section.
- B. This section is a Division 26 "Basic Materials and Methods" section, and is a part of each Division 26 section making reference to wiring devices specified herein.

#### **1.2 DESCRIPTION OF WORK**

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry, but not utilize electrical energy.
- B. Types of electrical wiring devices in this Section include the following:
  - 1. Receptacles
  - 2. Switches
  - 3. Wall Plates

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of wiring devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer: Qualified with at least 2 years of successful installation experience on projects with electrical installation work similar to that required for this project.

#### **1.4 REFERENCES**

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring devices.
- B. UL Compliance and Labeling: Provide electrical wiring devices which have been UL listed and labeled.
- C. NEMA Compliance: Comply with NEMA standards for general and specific purpose wiring devices.
- D. NECA Compliance: Comply with NECA's "Standard of Installation."

#### **1.5 SUBMITTALS**

WIRING DEVICES

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- A. Product Data: Submit manufacturer's data on electrical wiring devices.

## 2. PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:

1. Pass and Seymour Corporation
2. Cooper
3. Hubbell, Inc.
4. Leviton, Inc.
5. Crouse Hinds
6. Lutron

### 2.2 WIRING DEVICES

- A. General: Where shown on the drawings, furnish and install wiring devices indicated by the appropriate symbols. Wiring devices shall be products of Pass and Seymour Corporation, or equal. Catalog numbers shown below are P & S hard use specification grade. Similar devices manufactured by Hubbell or Leviton shall be equally acceptable.

- B. Switches: Branch circuit switches shall be flush tumbler type as follows:

1. Single Pole CSB20AC1 Series - Gray
2. Two Pole CSB20AC2 Series - Gray
3. Three-Way CSB20AC3 Series - Gray
4. Four-Way CSB20AC4 Series - Gray
5. Single Pole SW With Pilot CSB20-AC1-RPL Series
6. LED and Fluorescent Dimmer Switches: Provide dimmer switches capable of 0-10 Volt dimming of LED and fluorescent loads, Lutron NTF-10-277-Gray or engineer approved equal. Provide adequate number of conductors between dimmer switches and dimmed fixtures regardless of circuiting shown on drawings.
7. Switches fed by a generator circuit (standby or life safety) shall be the same as above but RED in color.

- C. Occupancy Sensors/Switches and Time Switches

1. See Plans for manufacturer and model number(s).

### 2.3 RECEPTACLES

- A. All receptacles shall be side and back wired, self-grounding of the type indicated on the drawings, or as follows. Catalog numbers shown below are Pass & Seymour specification grade unless otherwise indicated. Similar devices manufactured by Hubbell or Leviton shall be equally acceptable:

1. Duplex Convenience Receptacles CRB5362 Series-Gray

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20A-125V (Grounding Type)

- |    |   |  |
|----|---|--|
| 2. | Weatherproof Duplex Receptacles<br>20A-125V (Grounding Type)  | CRB5362-Gray-WP Series- with<br>Weatherproof Plate |
| 3. | Duplex GFI Receptacle<br>20A-125V   | 2095 Series-Gray                                   |
| 4. | Weatherproof Duplex<br>GFI Receptacle 20A-125 Volt  | 2097TRWR-Gray with WP Wall Plate                   |
| 5. | Duplex USB Receptacle   | TR5362USB-Gray                                     |
| 6. | Hospital Grade Receptacle<br>20A-125 Volt   | PS8300H Gray for Normal Power                      |
| 7. | Hospital Grade GFI Receptacle<br>20A-125 Volt   | 2095HG Gray for Normal Power                       |
| 8. | Tamper Resistance Receptacle  | TR63-Gray for Normal and                           |
| 9. | Switches fed by a generator circuit (standby or life safety) shall be the same as above but RED in color. |  |

2.4 PLATES

- A. Furnish and install wall plates for all wiring devices. Where switches and/or receptacles are shown adjacent to each other, provide a common cover plate for each group of devices. Oversize plates are not acceptable.
1. Plates shall be Pass and Seymour Type 302 stainless steel.
  2. Cover plates for all electrical devices shall be engraved with panel and circuit no. designation. Engraving shall be 1/8" high, block style letters, with black filler on front side of cover plates.
  3. Weatherproof switch plates shall **match existing building standard**.
  4. Weatherproof receptacle plates shall **match existing building standard**.

3. EXECUTION

3.1 INSTALLATION

- A. Install wiring devices as indicated in compliance with manufacturer's written instructions, applicable requirements of the NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

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- B. Coordinate with other work including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices and other work.
- C. Testing: Test wiring devices for electrical continuity of grounding connections and proper polarity. Test wiring devices to demonstrate compliance with requirements.
- D. Where devices are installed on exposed fittings or boxes, the plates shall be galvanized and of a type designed to fit the box. Blank covers shall be installed on all boxes without devices or fixtures, of same type as installed on devices in the room or area.
- E. All outlets shall be located as shown on the drawings, except that where practicable, outlets shall be located in center of panels or trim or otherwise symmetrically located to conform with existing structural layout. Outlets incorrectly installed shall be corrected. Damaged items or damaged finishes shall be repaired or replaced at no expense to the Owner.
- F. Outlets shall be set plumb or horizontal and shall extend to the finished surface of the walls, ceiling or floor, as the case may be, without projecting beyond the same.
- G. Receptacles, switches, etc., shown on wood trim, cases or other fixtures shall be installed symmetrically; and, where necessary, shall be set with the long dimensions of the plate horizontal, or ganged in tandem.
- H. Where dimmer switches are shown adjacent to standard switches, both shall be installed in separate back boxes with adequate space between so that neither cover plate requires cutting.
- I. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- J. Where devices are shown mounted adjacent to one another on the drawings, provide multi-gang faceplates to cover all devices.

END OF SECTION 26 27 26

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## **SECTION 26 29 13 - MOTOR CONTROLLERS**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to the work of this Section.
- B. Division 26 "Basic Electrical Materials and Methods" section apply to the work specified in this Section.
- C. Control Devices: Division 23 control devices such as aquastats, electric-pneumatic and pneumatic-electric switches, thermostats, freezestats, etc. are furnished and connected by the Division 23 Contractor unless specifically noted otherwise.
- D. Motors: All motors shown on the drawings shall be furnished and set in place under the specific section in which the motor is specified.
- E. Motor starters specified in other sections of this specification such as Division 23 shall be provided with power wiring by the Division 26 Contractor.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Type of motor starters specified in this Section are as follows:
  - 1. Full Voltage Non-Reversing Magnetic Starters
  - 2. Reduced Voltage Starters
  - 3. Manual Motor Starters
  - 4. Remote Controls

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacture of motor starters of types, ratings and characteristics required, whose products have been in satisfactory operation in similar service for not less than five (5) years.
- B. Firm with at least three (3) years of successful installation experience on projects utilizing motor starters similar to that required for this project.

#### **1.4 REFERENCES**



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- A. NEC Compliance: Comply with NEC requirements as applicable to wiring methods, construction, and installation of motor starters.
- B. NFPA Compliance: Comply with applicable requirements of NFPA standard 70E "Standard for Electrical Safety Requirements for Employee Workplaces."
- C. UL Compliance: Comply with applicable requirements of UL 486A "Wire, Connectors, and Soldering Lugs for Use with Copper Connectors," and UL 508 "Electrical Industrial Control Equipment" pertaining to the installation of motor starters. Provide motor starters and components which are UL listed and labeled.
- D. IEEE Compliance: Comply with applicable requirements of IEEE Standard 241 "Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to motor starters.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies," and Pub. No. 250, "Enclosures for Electrical Equipment (1000 volts Maximum)" pertaining to motor controllers/starters and enclosures.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's data on motor starters.
- B. Provide shop drawings of equipment being provided and control diagrams for each motor starter.

2. PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the requirements, provide motor starters of one of the following:
  - 1. Allen Bradley Co.
  - 2. General Electric Co.
  - 3. Siemens
  - 4. Square D Co.

2.2 GENERAL

- A. Except as otherwise indicated, provided motor starters and ancillary components which comply with the manufacturer's standard materials, and which are designed and constructed in accordance with published product information as required for a complete installation. Unless specifically indicated otherwise provide all power wiring, disconnects, starters, relays, hand-off-auto switches, pilot lights, motor connections, supports and all miscellaneous and necessary appurtenances required for a satisfactory and complete working system. **Provide all motor**

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**starters/controllers with NEMA 4/4X stainless steel enclosures in all rooms containing autoclave sterilizers and in all BSL3/ABSL3 barrier areas.**

### 2.3 FULL VOLTAGE NON-REVERSING MAGNETIC STARTERS

- A. Provide magnetic starters for three phase motors. Motor starters shall be full voltage non-reversing across the line magnetic type rated in accordance with NEMA standard sizes and horsepower ratings. Magnetic starters shall not be less than NEMA size one.
1. Each starter shall have a removable hinged cover capable of being padlocked. Enclosures shall be NEMA 1 general purpose type unless indicated otherwise. Provide watertight and dust tight enclosures for units installed outside, or as indicated on the drawings. Starters shall be provided with double break silver alloy contacts. All contacts shall be replaceable without removing wiring or the starter from the enclosure.
- B. Magnetic starters shall be provided with the following additional equipment:
1. Overload relays shall be an integral part of the motor starter. Overload relays shall have a minimum  $\pm 10$  percent adjustment from the nominal heater rating. Heaters shall be available such that when used with the  $\pm 10$  percent adjustment, a continuous selection of motor full load currents can be obtained through the size limitations of the starter. Overload relays shall be manual reset and field convertible from manual to automatic reset. Overload relays shall be melting alloy or bimetallic type. Thermal units shall be of one piece construction and interchangeable. The starter unit shall be inoperative if the thermal unit is removed. Provide 3 overload relays, one for each phase of the three phase starter.
  2. Starters shall be suitable for the addition of at least three normally open and three normally closed auxiliary contacts. Provide a minimum of two normally open and two normally closed contacts unless additional contacts are scheduled on the drawings or required for proper control of the equipment.
  3. In each magnetic starter provide cover mounted hand-off-auto selector switch complete with a manual overload reset button and a red "On" pilot light. Provide a control transformer with a secondary voltage of 120V, complete with primary overload and short circuit protection.
  4. Time delay relays with time delay after energization shall be provided for starters indicated, or as required for proper control of equipment. Time delay feature shall be adjustable from 0 to 60 seconds and set as indicated on the drawings.

### 2.4 PART WINDING REDUCED VOLTAGE MANETIC STARTERS

- A. Provide Allen-Bradley Bulletin 736 part-winding starters, closed-transition, magnetic, non-reversing, reduced-inrush, two-step type. Limit line current to a maximum of 65 percent of the locker rotor current. Coordinate and verify compatibility with the motor and driven equipment. Provide starter capable of interrupting 10 times motor full load rating.
- B. Provide starters with the equipment listed in paragraph 2.3, B above.

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- C. Provide additional equipment for combination starters in accordance with paragraph 2.3, B above.

## 2.5 WYE-DELTA REDUCED VOLTAGE MAGNETIC STARTERS

- A. Provide Allen-Bradley Bulletin 737 wye-delta starters, magnetic, non-reversing, reduced-inrush, closed-circuit transition type. Limit the inrush line current to a maximum of 35 percent of the locked rotor current. Coordinate and certify compatibility with the motor and driven equipment. Provide three thermal overload relays in series with each winding. Provide starter capable of interrupting 10 times motor full local rating.
- B. Provide starters with the equipment listed in paragraph 2.3, B above.

## 2.6 AUTO-TRANSFORMER REDUCED VOLTAGE MAGNETIC STARTERS

- A. Provide Allen-Bradley Bulletin 746 auto-Transformer starters, magnetic, non-reversing, reduced-inrush, closed-circuit transition type. Provide minimum tap of 65 percent for motors 30 hp or less, and 50 percent for motors in excess of 30 hp. Limit the inrush line current to a maximum of 43 percent and 25 percent respectively, of the locked rotor current. Provide thermal overload protection in each phase. Provide starter capable of interrupting 10 times motor full load rating.
- B. Provide starters with the equipment listed in paragraph 2.3, B above.

## 2.7 FULL VOLTAGE NON-REVERSING COMBINATION STARTERS

- A. Full voltage non-reversing combination starters shall be Square D Class 8538 (or equal) unless otherwise indicated. Provide additional equipment for combination starters in accordance with the requirements outlined in paragraph 2.3.2 above. Where combination starters are shown on the drawings, a separate starter and disconnect switch may be substituted at the Contractor's option, provided adequate space is available for the installation.
- B. Provide fused disconnect switches with Class R type fuse rejection clips. If breakers are shown, provide breakers with a minimum of 22,000 RMS symmetrical amps interrupting capacity.

## 2.8 MANUAL MOTOR STARTERS

- A. Thermal element type manual motor starters complete with melting alloy type thermal overload relays for single phase motors shall be Square D Class 2510. Provide overload relays sized in accordance with NEC requirements for the motor loads served.
- B. Provide flush mounted units in finished areas and surface mounted units in unfinished areas. Starter shall have NEMA I general purpose enclosure, unless otherwise indicated, and be rated for the motor horsepower required.

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## 2.9 REMOTE CONTROLS

- A. Provide Square D standard duty oil-tight pushbuttons, pilot lights, and/or selector switches where indicated on the drawings, or wherever required for proper control of the equipment. Units shall be flush mounted in finished areas and surface mounted in unfinished areas.

## 3. EXECUTION

### 3.1 INSTALLATION

- A. Install motor starters as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of the NEC, UL and NEMA Standards, to ensure that products fulfill requirements.
- B. Coordinate with other work including motor and electrical wiring/cabling work as necessary to interface installation of motor starters with other work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A.
- D. Install fuses in fusible disconnect switches as required.
- E. Adjusting and Cleaning: Inspect electrical starter's operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movements.
- F. Field Quality Control: Subsequent to connecting wire/cables, energize motor starter circuitry and demonstrate functioning of equipment in accordance with specified requirements. Where necessary, correct malfunctioning units and retest to demonstrate compliance. Ensure that direction of rotation of each motor fulfills requirements.

END OF SECTION 26 29 13

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## SECTION 26 41 00 – LIGHTNING PROTECTION SYSTEM

### PART 1. GENERAL

#### 1.1 SUMMARY

- A. **The LIDR building has an existing lightning protection system protecting the whole structure. The existing lightning protection system shall be modified to accommodate the renovated area of the roof as called out on the architectural and electrical plans. The modified portion of the lightning protection system shall fully integrate with and tie into the existing system so as to provide full protection of the building. The design of this system is to be in strict accordance with this section of the specifications and all contract drawings that apply.**
- B. The design of this system is to be in strict accordance with this section of the specifications and all contract drawings that apply.
- C. The lightning protection system shall be designed and installed by a firm actively engaged in the installation of Underwriters Laboratories Inc. (UL) Master Labeled Lightning Protection Systems and shall be so listed by Underwriters Laboratories Inc. The completed system shall comply with the latest editions of Underwriters Laboratories Inc. "Installation Requirements for Lightning Protection Systems, UL96A" and of the National Fire Protection Association's "NFPA® 780, Standard for the Installation of Lightning Protection Systems". The system shall be physically inspected by UL and the Master Label® Certificate of Inspection shall be provided to the building owner and made available for viewing on the UL website, <https://lps.ul.com>.
- D. The work covered under this section of the specification consists of furnishing labor, materials and services required for the completion of a functional and unobtrusive lightning protection system approved by the architect, engineer and Underwriters Laboratories Inc.
- E. System designs shall be completely integrated with the architectural design of the facility, and shall be reviewed by the Architect/Engineer prior to installation. The lightning protection system installation in shall be fully coordinated with all other trades.

#### 1.2 STANDARDS

- A. The completed lightning protection system shall comply with the latest issue of the following standards which form a part of this specification. Where conflict occur between the two standards, the requirements of NFPA®780 shall apply.
  - 1. NFPA® 780, Standard for the Installation of Lightning Protection Systems.
  - 2. UL 96A, Installation Requirements for Lightning Protection Systems.

#### 1.3 SUBMITTALS

LIGHTNING PROTECTION SYSTEM

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- A. **Product Data:** Submit manufacturer's descriptive and technical literature and catalog cuts.
- B. **Shop Drawings:** Submit installation shop drawings shall be submitted to the Architect and Engineer for coordination with other trades and approval prior to start of the installation. Shop drawings are to show the extent of the system layout designed specifically for the building(s) or structures included in the contract drawings along with installation details of the products to be used in the installation.

#### 1.4 QUALITY ASSURANCE

- A. The installing contractor shall apply for inspection of the completed system by UL field representatives. The system is to be inspected by Underwriters Laboratories Inc, or other ANSI certified testing agency for compliance with NFPA® 780. The system shall be without deviation and the UL field representative will issue a UL Master Label® Certificate of Inspection for Lightning Protection Systems or Letter of Findings at completion of the installation, as indicated in section 3.04 below.
- B. **Manufacturer:** Company specializing in lightning protection equipment with a minimum of five years of documented experience.
- C. **System Designer:** Company specializing in the design of lightning protection systems with a minimum of five years of documented experience.
- D. **Installer:** Authorized installer of system manufacturer with a minimum of five years of documented experience.

### PART 2. PRODUCTS

#### 2.1 MATERIALS

- A. All materials used in the installation shall be new and shall comply in weight, size and composition as required by UL 96A and NFPA® 780 and shall be labeled or listed by Underwriters Laboratories Inc. for use in lightning protection systems. The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment. The manufacturer shall be listed by UL as a manufacturer of lightning protection components.

#### 2.2 ACCEPTABLE MANUFACTURERS

- A. Harger Lightning & Grounding.
- B. National Lightning Protection Corporation.
- C. Robbins Lightning Protection Company.

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- D. Thompson Lightning Protection, Inc.
- E. Preferred Lightning Protection.

## 2.3 MATERIAL REQUIREMENTS

- A. Class I materials shall be used on structures or portions of structures that do not exceed 75 feet in height above grade level. Class II materials shall be used on structures that exceed 75 feet in height above grade.
- B. Copper materials shall not be mounted on aluminum, Galvalume®, galvanized steel or zinc surfaces. This includes those materials that have been painted.
- C. Aluminum materials shall not come into contact with earth or where rapid deterioration is possible. Aluminum materials shall not come into contact with copper surfaces or where exposed to runoff from copper surfaces. Aluminum materials shall not be attached to surfaces covered with alkaline-based paint, embedded in concrete or masonry, or installed in a location subject to excessive moisture.

## 2.4 AIR TERMINALS

- A. Air terminals shall extend a minimum of ten inches above the object or area they are to protect. Air terminals shall be located at intervals not exceeding 20'-0" along ridges of pitched roofs and along the perimeter of flat or gently sloping roofs (flat or gently sloping roofs include roofs that have a pitch less than 3:12). Flat or gently sloping roofs exceeding 50'-0" in width shall be provided with additional air terminals located at intervals not exceeding 50'. Air terminals shall be located within two feet of the ends of the ridges, roof edges and outside corners of protected areas.
- B. Air terminals shall be installed on stacks, flues, mechanical units and other objects not located within a zone of protection. Permanent metal objects on the structure having an exposed metal thickness 3/16" or greater may be substituted for air terminals and shall be connected to the lightning protection system as required by the specified standards using main size conductor and bonding plates having a minimum of 3 square inches of surface contact area.
- C. Air terminal bases shall be securely fastened to the structure in accordance with the specified standards. Fasteners may include stainless steel screws, bolts, nails, anchors or adhesive. Adhesive shall be compatible with the surface on which it is used. Any protective sheets or pads that may be required by the roofing manufacturer shall be furnished and installed by the roofing contractor.
- D. Main conductors shall be sized as Class I or Class II materials in accordance with the specified standards. Conductors shall provide a two way, horizontal or downward path from each strike or air terminal to connections to the lightning protection ground electrode system. Conductors shall be free of excessive splices and no bend of a conductor shall form an included angle of less than 90 degrees nor have a radius of bend less than 8 inches.



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- E. Conductors shall be securely fastened to the structure on which they are placed at intervals not exceeding 3 feet. Fasteners shall be of the same material or of a material equally resistant to corrosion as that of the conductor. Any protective sheets or pads that may be required by the roofing manufacturer shall be furnished and installed by the roofing contractor.
- F. Connector fittings shall be listed for the purpose and of the same material as the conductor or of electrolytically compatible materials.
- G. Down conductors shall be sized as Class I or Class II materials in accordance with the specified standards. Class II conductors from a higher portion of a structure shall continue to connections to the lightning protection ground electrode system. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors. Down conductors shall be concealed from view. All conductors shall be concealed from view at street level.
- H. In case of structural steel frame construction, down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals not exceeding 100 feet along the perimeter of the structure.

## 2.5 ROOF PENETRATIONS

- A. Roof penetrations required for down conductors or for connection to structural steel framework shall be made using thru-roof assemblies with solid riser bars or conduits and appropriate roof flashing. Conductors shall not pass directly through the roof. The roofing contractor shall furnish and install the materials required to properly seal all roof penetrations of the lightning protection components and any additional roofing materials or preparations required by the roofing manufacturer for lightning conductor runs to assure compatibility with the warranty for the roof including roof pads that may be required to protect the roof under each of the lightning protection components.

## 2.6 GROUND ELECTRODES

- A. Each down conductor shall terminate at a ground electrode dedicated to the lightning protection system, or to a building or facility ground electrode system that consists of multiple ground electrodes that are interconnected with a ground ring conductor.
- B. Ground rod electrodes shall be copper-clad steel, a minimum 5/8" diameter and 10 feet long. The down conductor shall be connected to the ground electrode using a bronze ground rod clamp having a minimum of 1½" contact between the ground rod electrode and the conductor measured parallel to the axis of the ground rod electrode, or by an Ultraweld exothermically welded connection. Ground rod electrodes shall be located a minimum of 2 feet below grade and shall be installed below the frost line where possible (excluding shallow topsoil conditions).
- C. Where it is not possible to drive ground rod electrodes because of bedrock or shallow topsoil conditions, ground plate electrodes, radial electrodes, ground ring electrodes, concrete-encased electrodes, or combinations of these may be used in accordance with NFPA® 780.

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- D. Where the structural steel framework is utilized as down conductors for the system, ground electrodes shall be connected to columns around the perimeter of the structure at intervals averaging not more than 60 feet apart. Columns shall be grounded using either bonding plates having 8 square inches of surface contact area or by Ultraweld® exothermically welded connections.

## 2.7 COMMON BONDING OF GROUNDED SYSTEMS

- A. Common bonding of all grounded systems within the building shall be ensured by interconnecting them to the lightning protection system using main size conductor and fittings.
- B. For structures exceeding 60 feet in height, the interconnection of the lightning protection system ground electrodes and other grounded systems shall be in the form of a ground loop conductor.
- C. These grounded systems shall include but are not limited to the electrical service, communication, and antenna system grounds as well as all underground metallic piping systems including water, gas, sewer, underground metallic conduits, etc. Interconnection to a gas line shall be made on the customer's side of the meter.

## 2.8 POTENTIAL EQUALIZATION

- A. Grounded metal bodies located within the required bonding distance as determined by the bonding distance formula in NFPA® 780 shall be bonded to the lightning protection system using the required bonding conductors and connections.

## PART 3. EXECUTION

### 3.1 INSTALLATION

- A. The installation of the lightning protection system shall be done in a neat and workmanlike manner.
- B. The lightning protection system shall be installed by or under the supervision of a UL listed lightning protection installer.
- C. The installers shall have completed factory training and be so certified by the manufacturer.
- D. Install the lightning protection system in accordance with the approved coordinated shop drawing and the referenced lightning protection system installation standards. Any deviations shall be brought to the immediate attention of the manufacturer so as not to delay certification.
- E. Splices and clamps: Install cable with as few joints as possible. Use approved exothermic welded connections for all above grade connections, ungrounded conductor splices and all underground connections between conductors and ground rods. Use approved mechanical compression connections for above grade connections with specific Owner approval only.

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- F. Systems shall be semi-concealed, with all down-lead conductors and groundings concealed within the building, but with roof conductors and air terminals exposed on roof. Where possible, roof conductors and air terminals shall be installed on inside faces of parapets so that they are not visible from below.
- G. Copper downlead conductors shall be used even when aluminum is required on the roof. Downlead cables in conduit shall not be brought directly through the roof. Thru roof assemblies with solid brass or stainless steel rods shall be utilized for this purpose.
- H. Ground Rods:
  - 1. Install rods by driving and not by drilling or jetting.
  - 2. Drive rods into unexcavated portions of the earth where possible.
  - 3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
  - 4. Drive to a depth such that the top of the rod will be approximately 18" below final grade or sub-grade.
  - 5. Bond exterior metal bodies on building to the lightning protection system.
- I. Corrosion Protection:
  - 1. Use no combination of materials that may form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist that would cause deterioration or corrosion of conductors, use conductors with suitable protective coatings. Protect cable at all points where cable leaves concrete by wrapping rubber tape 2" on either side of the plane formed by the finished concrete surface.

### 3.2 COORDINATION

- A. Coordinate the installation of the lightning protection system with other trades.
- B. Coordinate all roof penetrations, fasteners and adhesive with the roofing contractor prior to installing any materials on the roof.

### 3.3 PROJECT DOCUMENTATION

- A. Photo document all concealed portions of the lightning protection system as they are being installed. This includes lightning protection system grounding electrodes, connections to structural metal, connections to underground metal piping entering the structure, connections to electrical and electronic service grounds, ground rings, etc. This documentation should be authenticated by the Owner or his representative.
- B. Maintain accurate "as-built" drawings throughout the entire installation of the lightning protection system.

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### 3.4 INSPECTION, CERTIFICATION AND MAINTENANCE

- A. At completion of the installation of the lightning protection system, the contractor shall apply for inspection of the system by UL field representatives. The system is to be inspected for compliance with NFPA® 780.
- B. If the lightning protection system covers an entire independent structure and the system passes inspection, UL will issue a Master Label® Certificate of Inspection for Lightning Protection System. The contractor will submit the certificate for distribution to the premises' Owner. For the certificate to be valid, the contractor must publish the certificate to the UL website, <https://lps.ul.com> where it may be viewed by consumers, building owners, insurance agencies and other interested parties. The Master Label® Certificate of Inspection is valid for a period of five years. If the building changes structurally or if modifications are made to the system during that period, the certificate is no longer valid.
- C. At project closeout, the contractor shall provide the Owner with accurate as-built drawings as well as recommended guidelines for maintenance of the system.

END OF SECTION 26 41 00

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## **SECTION 26 51 00- LIGHTING**

### **1. GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections apply to the work of this Section.
- B. Division 26 "Basic Materials and Methods" sections apply to the work in this Section.

#### **1.2 DESCRIPTION OF WORK**

- A. Types of interior and exterior lighting fixtures in this Section include the following:
  - 1. LED

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in the manufacturer of interior and exterior light fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than three years.
- B. Installer: Qualified with at least three years of successful installation experience on projects with interior and exterior lighting fixture work similar to that required for this project.

#### **1.4 REFERENCES**

- A. NEC Compliance: Comply with the NEC as applicable to the installation and construction of lighting fixtures.
- B. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.
- C. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to interior and exterior lighting fixtures for hazardous locations.
- D. UL Compliance: Provide light fixtures that have been UL listed and labeled.
- E. NECA Compliance: Comply with NECA's "Standard of Installation".

#### **1.5 SUBMITTALS**

LIGHTING

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- A. **Product Data:** Submit manufacturer's product data on lighting fixtures.
- B. **SHOP DRAWINGS**
1. Furnish shop drawing portfolios (collated bound sets) containing the following information:
    - a. Name of manufacturer
    - b. Descriptive cut sheets
    - c. Complete photometric information
    - d. Coefficient of utilization tables
    - e. Fixture voltage
    - f. The number, type and wattage of the fixture lamps
    - g. Lens types
    - h. Fixture options
    - i. Fixture mounting details
    - j. Fixture door types
    - k. Construction of fixture housing and/or door
    - l. Fixture ballast manufacturer and type
  2. All lighting fixtures required to be used on this project shall be submitted in one single submittal so that all fixtures can be reviewed at one time. Those fixtures not receiving a shop drawing action of "Reviewed" or "Reviewed and Noted" on the first submittal shall be resubmitted for review. A light fixture receiving a shop drawing action of "Resubmit" or "Rejected" after the third review for any reason, shall be furnished as originally specified.
  3. The portfolios shall be made from standard manufacturer's specification sheets. Each fixture shall be identified by the letter or number indicated on the fixture schedule. The combining of more than one fixture type of fixture on a single sheet shall not be acceptable.

**2. PRODUCTS**

- 2.1 **Manufacturer:** Manufacturers of lighting fixtures are noted on the drawings by notes and/or by the light fixture schedule.
- 2.2 **Substitutions:** If the Contractor proposes to substitute lighting fixtures for those shown on the drawings or specified herein, he shall submit a list of proposed fixtures together with technical data to substantiate that the substitute fixtures are equivalent in all respects to the specified equipment. Proposed substitute fixtures must be submitted to the architect/engineer for review a minimum of ten (10) days prior to the project bid date. Only original documentation will be accepted for review. After review of the proposed substitute fixtures, an addendum or bid bulletin will be issued to include acceptable equipment. The review of substitute equipment in no way relieves the contractor of the responsibility to provide equipment that is equivalent in all respects to specified fixtures. Lighting fixtures as shown on the drawings or specified herein shall be used as a basis and standard of comparison in the review and consideration of fixtures

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of other manufacturers. The Architect/Engineer shall have the final authority as to whether the fixture is equivalent to the specified item. The proposed substitution may be rejected for the aesthetic value if felt necessary or desirable. In the event the proposed substitutions are rejected, the Contractor shall furnish the specified item.

## 2.3 LED Drivers

- A. Driver shall operate from 60 Hz input source of 120V through 277V with sustained variations of +/- 10 percent (voltage and frequency).
- B. Driver input current shall have Total Harmonic Distortion (THD) of less than 20 percent when operated at nominal line voltage.
- C. Driver shall have a Power Factor greater than 0.90.
- D. Driver shall avoid interference with infrared devices and eliminate visible flicker.
- E. Driver shall comply with ANSI C62.41 Category A for Transient protection.
- F. Driver shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- G. The luminaire shall be capable of continuous dimming over a range of 100% to 5% of rated lumen output. Dimming shall be controlled by a 0-10VDC signal.
- H. Control device must be compatible with type of driver, and coordinated prior to submission of shop drawings.
- I. If driver is remote-mounted, provide maximum allowable distances for secondary wire runs to luminaires.
- J. Provide with mounting hardware as required.

## 2.4 LED's

- A. Color temperature specified shall be uniform for all LED modules within like luminaire types. Color temperature measurement shall have a maximum 2 SDCM on the MacAdam Ellipse.
- B. Correlated color temperature to match existing building standard unless otherwise specified. Minimum color rendering index (CRI) of 85.
- C. LED light output and efficacy shall be measured in accordance with IES LM-79 standards.



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- D. LED life and lumen maintenance shall be measured in accordance with IES LM-80 standards.
- E. Rated minimum life of 50,000 hours.
- F. The individual LED's shall be connected such that a catastrophic loss or the failure of one LED will not result in a light output loss of the entire luminaire.

## 2.5 PLASTER FRAMES

- A. Standard plaster frames shall be provided for all recessed lighting fixtures installed in plaster or drywall finished walls or ceilings. Coordinate with architectural drawings.

## 3. EXECUTION

### 3.1 INSTALLATION

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of the NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other electrical work as appropriate to properly interface installation of lighting fixtures with other work.
- C. Adjust and Clean: Clean lighting fixtures of dirt and debris upon completion of the installation. Protect installed fixtures from damage during the remainder of the construction period.
- D. Field Quality Control: Upon completion of the installation of lighting fixtures, and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with the requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- E. Lighting fixture supports: Properly support and install fixtures in strict accordance with all applicable building codes and standards. Fully and completely coordinate the installation of fixtures with actual ceiling systems, and with all building trades. In general, provide fixture supports according to the following (unless applicable codes require more restrictive support details):
  - 1. All lighting fixtures installed in grid type suspended ceiling systems, shall be positively attached to the ceiling system with clips that are UL listed for the application. In addition, a minimum of four (4) ceiling support system rods or wires shall be provided for each light fixture and shall be installed not more than six (6) inches from fixture corners. Provide two (2) No. 12 gage hangers from each fixture housing to the building structure above (wires may be installed slack). Light fixtures that weigh more than 56 pounds shall be

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supported directly from the structure above by UL listed and approved hangers. Light fixtures that are smaller than the ceiling grid shall be installed at locations indicated on the reflected ceiling plans, or shall be installed in the center of the ceiling panel and shall be supported independently by at least two metal channels that span and are secured to the ceiling system.

2. Suspended lighting fixtures shall be supported directly from the building structure without using suspended ceilings as support systems. Support systems shall be UL listed and approved for the specific installation. Where pendants or rods exceed 48 inches in length, brace support systems to limit swinging.
- F. Square and rectangular fixtures shall be mounted with sides parallel to building and ceiling lines, unless otherwise noted.
- G. Where special fixtures to be used in special ceilings are scheduled, verify all ceiling system details and coordinate fixture type and accessories prior to ordering fixtures. Coordinate and cooperate with ceiling system supplier in the preparation of ceiling system shop drawings.
- H. Install fixtures as recommended by the manufacturer, or as necessary to provide exact horizontal alignment, preventing horizontal or vertical deflection, or angular jointing of fixtures suspended in continuous rows.

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## **SECTION 32 31 19 – STEEL SECURITY FENCE SYSTEM**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Work shall include all labor, materials, and equipment necessary to completely furnish and install the Chain Link Fences and Gates as indicated on the plans and as herein specified.
- B. This Section includes the following:
  - 1. Steel Security Fencing
  - 2. Steel Security Swing Gates and Hardware
  - 3. Gate Operators
  - 4. Electromechanical Gate Locks
- C. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 033000 “Cast-in-Place Concrete” for Cast-in-place concrete

#### **1.3 SYSTEM DESCRIPTION**

- A. The manufacturer shall supply a total fence system of Montage II® Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel Classic™ design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

#### **1.4 QUALITY ASSURANCE**

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

#### **1.5 REFERENCES**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

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- E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.6 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design security fence and gates, including comprehensive engineering analysis by a qualified professional engineer registered in the State of Missouri, using performance requirements and design criteria indicated.
- B. Structural Performance: Provide security fence and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:
    - a. Wind Speed: 90 mph.
    - b. Fence Height: See Drawings.
    - c. Wind Exposure Category: C
  - 2. Sizes for all fence posts shall be determined solely by the contractor based on information provided above, information listed in this specification and information provided on the drawings. Post sizes listed on the drawings are for information only and shall be confirmed by the contractor. Exact sizes for all posts required to accommodate stipulated conditions shall be incorporated as part of the base bid.

1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain link fence and gates.
  - 1. Fence and gate posts, rails, and fittings
  - 2. Gate hardware
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

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- C. Samples for Verification: Prepared on Samples
- D. Delegated-Design Submittal: For chain-link fence and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: For each type of chain-link fence, and gate, from manufacturer.
- F. Product Test Reports: For framing strength according to ASTM F 1043
- G. Field quality-control reports
- H. Operation and Maintenance Data: For the following to include in emergency, operations, and maintenance manuals:
  - 1. Gate hardware

## 1.8 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

## 1.9 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

## PART 2 MATERIALS

### 2.1 MANUFACTURER

- A. The fence system shall conform to Montage II® Welded and Rackable (ATF – All Terrain Flexibility) Ornamental Steel, Classic™ design, extended picket bottom rail treatment as required to match existing, 3-Rail style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma.

### 2.2 MATERIAL

STEEL SECURITY FENCE SYSTEM

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- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft<sup>2</sup> (276 g/m<sup>2</sup>), Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x .105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

## 2.3 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 12ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'. At vehicle swing gate, ensure bottom meets entrapment requirements and is reinforced as required for operator location(s).
- F. Pedestrian swing gates shall be self-closing. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5" x 6" footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5" - 1.375") and vertical (0 - .5"). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

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## 2.4 GATE OPERATOR

- A. Manufacturers: Subject to compliance with requirements, furnish basis-of-design product or equal product as approved by architect:
  - 1. DoorKing, Model 6006
- B. Standards: UL 325 Class I and Class II
- C. Speed: 90 Degrees in 20 seconds maximum.
- D. Coordinate gate leaf maximum weight and length with gate operator and gate manufacturer. Provide quantity of operators as required for gate.
- E. Provide inswing or pulling option, and provide any required mounting brackets for proper gate operation. Provide reversing edge on leading gate edge and bottom of gate leaf. Provide photo-beam posts and sensors as required for gate operation.
- F. Electrical: Refer to drawings and manufacturer for electrical requirements.
- G. Provide electronic manual gate operation panel for open/close at secure side.

## 2.5 ELECTROMECHANICAL GATE LATCH

- H. Manufacturers: Subject to compliance with requirements, furnish basis-of-design product or equal product as approved by architect:
  - 1. Securitron, Model GL1-FSM
- I. Standards: UL 294 Listed
- J. Holding Force: 2,000 lbs
- K. Provide where indicated on drawings as retrofit to existing and new pedestrian gates in security fence. Provide FMK-SW or equivalent mounting kit for swinging gate.
- L. Electrical: Refer to drawings and manufacturer for electrical requirements.
- M. Provide electronic manual gate operation on secure side of gate.



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### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

#### **3.2 FENCE INSTALLATION**

- A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

#### **3.3 FENCE INSTALLATION MAINTENANCE**

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

#### **3.4 GATE INSTALLATION**

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

#### **3.5 CLEANING**

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

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<b>Table 1 – Minimum Sizes for Montage II Posts</b>			
<u>Fence Posts</u>		<u>Panel Height</u>	
2-1/2" x 12 Ga.		Up to & Including 6' Height	
3" x 12 Ga.		Over 6' Up to & Including 8' Height	
<u>Gate Leaf</u>	<u>Gate Height</u>		
	<u>Up to &amp; Including 4'</u>	<u>Over 4' Up to &amp; Including 6'</u>	<u>Over 6' Up to &amp; Including 8'</u>
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

<b>Coating Performance Requirements</b>		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Span	For CLASSIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± 1/2" O.C.	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

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