

PROJECT MANUAL FOR:

# Barnard Room 8 Quantum Foundry Renovation

MONTANA STATE UNIVERSITY  
BOZEMAN, MONTANA

**May 23, 2024**

**PPA No. 21-0186**



**MONTANA**  
STATE UNIVERSITY

UNIVERSITY FACILITIES MANAGEMENT  
BOZEMAN, MONTANA  
PHONE: (406) 994-5413 FAX: (406) 994-5665



**HIGH PLAINS**  
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## UNIVERSITY FACILITIES MANAGEMENT

Sixth Avenue and Grant Street • P.O. Box 172760 • Bozeman, Montana  
59717-2760 Phone: (406) 994-5413 • Fax: (406) 994-5665

### PERMIT NOTICE

The drawings and specifications for this project have been submitted to the city of Bozeman for review. The contractor will pay all permit fees. The owner shall pay for plan review fee and the impact fee required for this project. The building permit must be appropriately displayed at the project site before construction may begin. The contractor shall contact the city of Bozeman for further clarification at the following:

CITY OF BOZEMAN  
BUILDING INSPECTION DIVISION  
DEPARTMENT OF PUBLIC  
WORKS 20 EAST OLIVE STREET,  
SUITE 208 PO BOX 640  
BOZEMAN, MONTANA  
59771-0640 (406) 582-2300

BUILDING PERMIT



## INVITATION TO BID

Sealed bids will be received until **2:00 PM on Tuesday, June 18, 2024**, and will be publicly opened and read aloud in the offices of **MSU University Facilities Management, Plew Building, 6<sup>th</sup> & Grant, Bozeman, Montana**, for: **Barnard 008 Quantum Foundry Renovation, PPA No. 21-0186**.

Bids shall be submitted on the form provided within the Contract Documents. Contract documents may be obtained at the offices of:

**Montana State University  
UNIVERSITY FACILITIES MANAGEMENT  
Plew Building, 6<sup>th</sup> & Grant  
PO Box 172760  
Bozeman, Montana 59717-2760**

**On the web at:**  
<http://www.montana.edu/pdc/bids.html>

***A PRE-BID WALK-THROUGH IS SCHEDULED FOR June 3, 2024, AT 10:00 AM. PARTICIPANTS SHOULD MEET AT Barnard Hall, room 008. ATTENDANCE IS STRONGLY RECOMMENDED. QUESTIONS RECEIVED AFTER THIS DATE, WILL BE RESPONDED TO AT THE OWNER'S DISCRETION. Bidders should thoroughly review the contract documents before the pre-bid conference.***

Bids equal to or greater than \$150,000 must be accompanied by a bid security meeting the requirements of the State of Montana in the amount of 10% of the total bid. After award, the successful bidder must furnish an approved Performance Security and a Labor & Material Payment Security each in the amount of 100% of the contract for contracts equal to or greater than \$150,000.

No bidder may withdraw his bid for at least thirty (30) calendar days after the scheduled time for receipt of bids except as noted in the Instructions to Bidders.

The Owner reserves the right to reject any or all bids and to waive any and all irregularities or informalities and the right to determine what constitutes any and all irregularities or informalities.

### Time of Completion

Bidder agrees to commence work immediately upon receipt of the Notice to Proceed and to substantially complete the project by **December 31, 2024**.

*The State of Montana makes reasonable accommodations for any known disability that may interfere with an applicant's ability to compete in the bidding and/or selection process. In order for the state to make such accommodations, applicants must make known any needed accommodation to the individual project managers or agency contacts listed in the contract documents.*

State of Montana - Montana State University

## INSTRUCTIONS TO BIDDERS

1. Table of Contents

**Provided in the Printed Project Manual:**

Invitation to Bid  
Instruction to Bidders  
Bid Proposal, Form 098  
Sample Standard Form of Contract  
State of Montana General Conditions  
MSU Supplementary Conditions  
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Periodic Estimate for Partial Payment, Form 101  
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Certificate of Final Acceptance, Form 118  
Buy-Safe Montana Form

**These additional forms can be found on our website or will be provided upon request:**

<http://www.montana.edu/pdc/docs/index.html>

Substitution Request, Form 99  
Schedule of Values, Form 100

**For most current Montana Prevailing Wage Rates applicable to this project download from this site: <http://erd.dli.mt.gov/labor-standards/state-prevailing-wage-rates>**

2. Viewing of Contract Documents

2.1. The Contract Documents may be viewed at the following locations:

Builders Exchange of Billings  
2050 Broadwater STE A  
Billings MT 59102  
406/652-1311  
[bbx@billingsplanroom.com](mailto:bbx@billingsplanroom.com)

NW MT - Flathead Builders  
Exchange  
2303 Hwy 2 E  
Kalispell, MT 59901  
406/755-5888  
[planex@kalcopy.com](mailto:planex@kalcopy.com)

Helena Plans Exchange  
1530 Cedar Street Suite C  
Helena MT 59601  
406/457-2679  
[helenaplanex@helenacopycenter.com](mailto:helenaplanex@helenacopycenter.com)

Bozeman Builders Exchange  
1105 Reeves RD W STE 800  
Bozeman MT 59718  
406/586-7653  
[exchange@bozemanplanroom.com](mailto:exchange@bozemanplanroom.com)

Great Falls Builders Exchange  
202 2ND Avenue S  
Great Falls MT 59401  
406/453-2513  
[gfbe@greatfallsplans.com](mailto:gfbe@greatfallsplans.com)

Missoula Plans Exchange  
201 N Russell ST  
Missoula MT 59801  
406/549-5002  
[mpe@vemcoinc.com](mailto:mpe@vemcoinc.com)

Butte Builders Exchange  
4801 Hope Road  
Butte MT 59701  
406/782-5433  
[butteplans@gmail.com](mailto:butteplans@gmail.com)

3. Borrowing of Documents: Up to two hard copy sets may be obtained for General Contractors. Additionally, Contract Documents will be available electronically. If shipping of hard copies is required, it will be at the contractor's expense.

3.1. Contract Documents may be obtained at the office of:

**MONTANA STATE UNIVERSITY  
UNIVERSITY FACILITIES MANAGEMENT  
PLEW BUILDING 1st FLOOR  
6TH AND GRANT  
BOZEMAN, MONTANA 59717-2760  
406/994-5413**

3.2. All borrowed Contract Documents shall be returned to University Facilities Management within ten (10) calendar days after the bid opening for the deposit refund (if deposit was required). However, if the Contract Documents are not in a condition where they can be reused by the



Owner to construct the project, the Owner may at its sole discretion may retain the deposit or levy costs to contractor in order to reproduce a replacement set.

4. Visits to Site

4.1. Prospective bidders are requested to contact the following for inspection of the site:

**Jennisse Waters, Project Manager  
Montana State University  
University Facilities Management  
6<sup>th</sup> and Grant, PO Box 172760  
Bozeman, Montana 59717-2760  
Ph: 406/994-5970**

4.2. Failure to visit site will not relieve the Contractor of the conditions of the contract.

5. Requests for Substitution

5.1 Any requests for product substitutions must be submitted on the "Substitution Request" Form 099, to the Architect/Engineer at least ten (10) days prior to the date of the bid opening for consideration by the Architect/Engineer. Any request for substitution made after this time restriction, including those made after award during project construction may be rejected without consideration by either the Architect/Engineer or the Owner.

6. Bids/Proposals

6.1. The bidder shall submit his bid on the Bid Proposal Form furnished with the Contract Documents.

6.2. DO NOT send the Contract Documents with the Proposal. The Contract Documents shall be returned as noted in Article 3.2 of the Instructions to Bidders.

6.3. If the project is funded by any portion of federal funds, the following may apply: on Federally-funded projects, a "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion" form must be submitted with the bid proposal. If the debarment form is not included within the Construction Documents, federal funds (if included) do not require the form or are not included in the project and the debarment form is not required.

6.4. Proposals shall be in a sealed envelope and addressed to:

**STATE OF MONTANA, MONTANA STATE UNIVERSITY  
UNIVERSITY FACILITIES MANAGEMENT  
PLEW BUILDING 1ST FLOOR  
6TH AND GRANT  
PO BOX 172760, BOZEMAN, MONTANA 59717-2760**

6.5. The envelope shall state that it contains a "BID PROPOSAL" and indicate the following information:

Name of Project: Barnard 008 **Quantum Foundry Renovation**  
Location: **Montana State University Bozeman Campus**  
MSU PPA Project Number: 21-0186  
Name of Bidder: \_\_\_\_\_  
Acknowledge Addendum Number: \_\_, \_\_, \_\_, \_\_

6.6. It is the bidder's responsibility to deliver or ensure delivery of the bid proposal to Montana State University, University Facilities Management. Proposals received after the scheduled closing time for bids by either the bidder, a delivery service (e.g. Federal Express, U.S. Postal Service, United Parcel Service, etc.), or the state's own mail delivery system, will be rejected. Proposals entitled for consideration must be time-stamped in the Owner's office prior to the closing time for receipt of bids. The official time clock for receipt of bids and fax modifications is the Owner's time and date stamp clock located in the reception area of the Owner's office. No other clocks, calendars or timepieces are recognized. All bidders are responsible to ensure all bids and fax modifications are received in the Owner's office prior to the scheduled closing time.

- 6.7. If requested on the Bid Proposal, any person making a bid to perform the Work shall, as a requirement of a responsible bid, set forth the name of each subcontractor specified in the "List of Subcontractors" which is part of the bid proposal. The bidder shall list only one subcontractor for each such portion or work listed. The bidder whose bid is accepted shall not:
  - 6.7.1. Substitute any other subcontractor in place of the subcontractor listed in the original bid, except by specific consent of the Owner. The Owner, at its sole discretion, may grant substitution with consent of the originally listed subcontractor, or in consideration of other factor(s) involved if deemed relevant to the successful performance of the Contract.
  - 6.7.2. Permit any such subcontract to be voluntarily assigned, transferred or allow it to be performed by any party other than the subcontractor listed in the original bid without the consent of the Owner.
- 6.8. Bid Proposals entitled to consideration shall be made in accordance with the following instructions:
  - 6.8.1. Made upon form provided;
  - 6.8.2. All blank spaces properly filled;
  - 6.8.3. All numbers stated in both writing and in figures;
  - 6.8.4. Shall contain no additions, conditional or alternate bids, erasures or other irregularities;
  - 6.8.5. Shall acknowledge receipt of all addenda issued.
- 6.9. Bid Proposals entitled to consideration shall be signed by the proper representative of the firm submitting the proposal as follows:
  - 6.9.1. The principal of a single owner firm;
  - 6.9.2. A principal of a partnership firm;
  - 6.9.3. An officer of an incorporated firm, or an agent whose signature is accompanied by a certified copy of the resolution of the Board of Directors authorizing that agent to sign; or,
  - 6.9.4. Other persons signing for a single-owner firm or a partnership shall attach a power-of-attorney evidencing his authority to sign for that firm.
- 6.10. Unit Prices: When a Bid Proposal Form contains unit prices, any errors discovered in the extension of those unit prices will be corrected by the Owner using the unit price figures. The adjusted extended amount will then be used to determine the correct total bid. Only after the amounts have been checked and adjusted, if necessary, will the valid low bid be determined.
- 6.11. Estimated Quantities: All estimated quantities stipulated in the Bid Proposal and other Contract Documents are approximate and are to be used only as a basis for estimating the probable cost of the work and for the purpose of comparing proposals submitted for the work. It is understood and agreed that the actual amounts of work done, and materials furnished under unit price items may vary from such estimated quantities. The actual quantities will depend on the conditions encountered at the time the work is performed.
- 6.12. Any bidder may modify his bid by fax communication only.
  - 6.12.1 It is the bidder's responsibility to ensure that the entire modification is received at the bid opening location prior to the scheduled closing time for receipt of bids. The modification shall not reveal the bid price but shall only provide the ADDITION or SUBTRACTION from the original proposal.
  - 6.12.2 The Owner is not responsible for the performance of the facsimile/printer machine, maintaining adequate paper levels, toner levels, the telephone connection, quality of the facsimile, or any other factors affecting receipt of the fax. Unreadable or difficult-to-read facsimiles may be rejected at the sole discretion of the Owner.
  - 6.12.3 Changes in the listed subcontractors, if any, shall also be provided.
  - 6.12.4 Bid modifications must be verified by hard copy provided to the Owner within two (2) business days after the bid opening.
  - 6.12.5 Bid modifications shall be directed to fax phone (406) 994-5665.
  - 6.12.6 All facsimiles shall be date and time stamped on the same time-stamp clock in the Owner's office that is used for receipt of bids in order to be considered valid. The Owner may also use the date and time on the automatically-generated email notification of

facsimile receipt as generated by the State's system. Any date and time indicated at the top of the facsimile on either the bidder's or the Owner's facsimile/printer machine will not be used in determining time of arrival of the modification.

- 6.13. The Owner reserves the sole right to reject any or all bids and to waive any irregularities or informalities. The Owner also reserves the sole right to determine what constitutes irregularities or informalities and/or what is material and/or immaterial to the bids received.

## 7. Bid Security

- 7.1. IF THE PROJECT COST IS LESS THAN \$25,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE BID SECURITY (18-2-302 MCA).
- 7.2. Proposals over \$150,000 shall be accompanied by a bid security in the amount of 10% of the bid price, as evidence of good faith (18-2-302 MCA).
- 7.3. Bid security shall be in the form of lawful moneys of the United States, cashier's check, certified check, bank money order or bank draft, bid bond or bonds payable to the State of Montana (18-2-302 MCA).
- 7.4. If the bidder, to whom a contract is awarded, fails to enter into and execute the proposed contract within fifteen (15) calendar days of award, the bidder shall forfeit the bid security (18-1-204 MCA).
- 7.5. The bid security of unsuccessful bidders will be returned when the contract has been awarded to the successful bidder or when all bids have been rejected (18-1-205 MCA).
- 7.6. Execution of and entering into a contract includes providing all necessary insurance certificates, bonds, signed contract and current copy of the construction contractor registration certificate.
- 7.7. **NOTE: PER STATE POLICY, IF CASH, CHECK, MONEY ORDER, OR BANK DRAFT ARE PROVIDED AS BID SECURITY, IT WILL BE DEPOSITED IN THE TREASURY. UNSUCCESSFUL BIDDERS WILL HAVE THEIR SECURITY RETURNED UPON CONTRACT AWARD. THE SUCCESSFUL BIDDER'S SECURITY MAY BE RETURNED UPON ISSUANCE OF NOTICE TO PROCEED.**

## 8. Withdrawal of Bids

- 8.1. Any bidder may withdraw his bid proposal at any time prior to the scheduled closing time for the receipt of bids.
- 8.2. Once the closing time for the receipt of bids is reached, a bid may not be withdrawn for a period of thirty (30) calendar days.

## 9. Interpretation of Contract Documents

- 9.1. Bidders shall promptly notify the Architect/Engineer of any ambiguity, inconsistency, or error which they may discover upon examination of the Contract Documents or of the site and local conditions.
- 9.2. Bidders requiring clarification or interpretation of the Contract Documents shall request, in writing, clarification from the Architect/Engineer at least ten (10) calendar days prior to the date set for receipt of bids.
- 9.3. Any interpretations, corrections, or change in the Contract Documents prior to the bid opening will be made by written addendum issued by the Architect/Engineer. The Architect/Engineer will endeavor to notify all plan holders of any addenda issued but it shall be the responsibility of the individual bidders to insure they have received all addenda prior to the submission of their bid.
- 9.4. All written addenda issued by the Architect/Engineer will become part of the Contract Documents and all bidders shall be bound by such addenda whether or not received and/or acknowledged by the bidder. No oral or telephone modifications of the Contract Documents will be considered or allowed.

## 10. Award of Bids

- 10.1. All bids received by the stated hour will be opened and publicly read aloud.
- 10.2. The Owner reserves the right to reject any and all bids and to waive any informality or irregularity in any bid received. Owner reserves the right to determine what constitutes material and/or immaterial informalities and/or irregularities.
- 10.3. The low bid shall be determined on the basis of the lowest Base Bid or the lowest combination of Base Bid and Alternate Bids, accepted in consecutive order.
- 10.4. The Owner shall award such contract to the lowest responsible bidder (18-1-102 MCA).
  - 10.4.1. The Owner may make such investigations as it deems necessary to determine whether or not any or all bidders are responsible.
  - 10.4.2. The term "responsible" does not refer to pecuniary ability only, nor the ability to tender sufficient performance and payment bonds.
  - 10.4.3. The term "responsible" includes, but is not limited to:
    - 10.4.3.1. Having adequate financial resources to perform the contract or the ability to obtain them;
    - 10.4.3.2. Being able to comply with the required delivery, duration, and performance schedule;
    - 10.4.3.3. Having a satisfactory record of integrity and business ethics;
    - 10.4.3.4. Having the necessary organization, experience, accounting, and operational controls;
    - 10.4.3.5. Having the necessary production, construction, technical equipment, and facilities; and,
    - 10.4.3.6. Having the technical skill, ability, capacity, integrity, performance, experience, lack of claims and disputes, lack of actions on bonds, lack of mediations, arbitrations and/or lawsuits related to construction work or performance, and such like.
  - 10.4.4. Bidders shall furnish to the Owner all information and data for this purpose as the Owner may request.
  - 10.4.5. The Owner reserves the right to reject any bid if the investigation or evidence of any Bidder fails to satisfy the Owner that such Bidder is properly and adequately qualified to suitably perform and satisfactorily execute the obligations of the Contract and Work defined in the Contract Documents.
- 10.5. The Owner shall award such contract to the lowest responsible bidder without regard to residency except on a reciprocal basis: a resident bidder will be allowed a preference on a contract against the bid of any non-resident bidder from any state or country that enforces a preference for resident bidders. The preference given to resident bidders of the State of Montana must be equal to the preference given in the other state or country (18-1-102, MCA). This does not apply when prohibited by Federal requirements.
- 10.6. The State of Montana may negotiate deductive changes, not to exceed 15% of the total cost of the project, with the lowest responsible bidder when the lowest responsible bids causes the project cost to exceed the appropriation; or with the lowest responsible bidders if multiple contracts will be awarded on the projects when the total of the lowest responsible bids causes the project cost to exceed the appropriation. A bidder is not required to negotiate his bid but is required to honor his bid for the time specified in the bidding documents. The Owner may terminate negotiations at any time (18-2-105(7) MCA).

## 11. Contract

- 11.1. The sample Standard Form of Contract between Contractor and Owner, as issued by the Owner, will be used as the contracting instrument and is bound within the Contract Documents.
- 11.2. The form shall be signed by a proper representative of the bidder as defined above in these instructions.
- 11.3. The contractor shall also complete and return a federal form W-9 with the Contract.

## 12. Performance, Labor and Material Payment Security

- 12.1. IF THE PROJECT COST IS LESS THAN \$150,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE A PERFORMANCE OR LABOR AND MATERIAL PAYMENT SECURITY (18-2-201 MCA). **(MSU REQUIRES BONDS ON ALL PROJECTS ABOVE \$150,000.)**
- 12.2. THE CONTRACTOR SHALL PROVIDE BOTH SECURITIES FOR THIS PROJECT AS SPECIFIED BELOW, UNLESS SPECIFICALLY DIRECTED THAT THIS REQUIREMENT HAS BEEN WAIVED ELSEWHERE IN THESE DOCUMENTS.
- 12.3. The Owner shall require the successful bidder to furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201, MCA).
- 12.4. The Owner shall require the successful bidder to furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201 MCA).
- 12.5. The bonds shall be executed on forms furnished by the Owner. No other forms will be acceptable.
- 12.6. The bonds shall be signed in compliance with State statutes (33-17-111 MCA).
- 12.7. Bonds shall be secured from a State licensed bonding company.
- 12.8. Power of Attorney
  - 12.8.1. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney;
  - 12.8.2. One original copy shall be furnished with each set of bonds.
  - 12.8.3. Others furnished with a set of bonds may be copies of that original.
13. Notice To Proceed
  - 13.1. The successful bidder who is awarded the contract for construction will not be issued a Notice to Proceed until there is a signed Contract, the specified insurance certificates and a copy of the bidder's current Construction Contractor Registration Certificate in the Owner's possession. All items are required within fifteen (15) calendar days of contract award made by the Owner.
14. Laws and Regulations
  - 14.1. The bidders' attention is directed to the fact that all applicable federal and state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over the project shall apply to the contract throughout and will be deemed to be included in this contract as if bound herein in full.
15. Payments
  - 15.1. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.
16. Buy Safe Montana Provisions
  - 16.1. The successful bidder who is awarded the contract for construction shall provide their incident rate, experience modification ratio (EMR) and loss ratio via the Buy-Safe Montana form with the Award documents.
17. Time of Completion
  - 17.1. Bidder agrees to commence work immediately upon receipt of the Notice to Proceed and to substantially complete the project by **December 31, 2024**.

- 17.2. If liquidated damages are assessed for exceeding the completion date, they shall accrue at the rate of **ONE THOUSAND AND NO/100 (\$1,000.00) DOLLARS** per calendar day. Liquidated damages charges will be deducted from the amount due the Contractor

**~END OF INSTRUCTIONS~**



BID PROPOSAL
BARNARD ROOM 8 QUANTUM FOUNDRY RENOVATION
PPA No. 21-0186

TO:
State of Montana, Montana State University
University Facilities Management
Attn: Contract Administrator
Plew Building, 6th & Grant,
PO Box 172760
Bozeman, Montana 59717-2760

Prospective Bidders:

The undersigned, having familiarized themselves with the Contract Documents, site, location, and conditions of the Work as prepared by HIGH PLAINS ARCHITECTS, 2720 MINNESOTA AVE, 406-896-0250, by submission of this Bid Proposal, hereby agrees to provide all materials, systems, equipment and labor necessary to complete the Work for the total sum as follows:

BASE BID:

\_\_\_\_\_ and \_\_\_\_\_ /100 DOLLARS
(ALPHA notation) \$ \_\_\_\_\_ (NUMERIC notation)

ALTERNATE NO. 1: ADD (FLUID-APPLIED FLOORING)

THE BIDDER AGREES TO ADD THE SPECIFIED SCOPE OF WORK FOR THE TOTAL SUM OF:

\_\_\_\_\_ and \_\_\_\_\_ /100 DOLLARS
(ALPHA notation) \$ \_\_\_\_\_ (NUMERIC notation)

ALTERNATE NO. 1: DEDUCT (DOMESTIC WATER BACKUP SYSTEM)

THE BIDDER AGREES TO DEDUCT THE SPECIFIED SCOPE OF WORK FOR THE TOTAL SUM OF:

\_\_\_\_\_ and \_\_\_\_\_ /100 DOLLARS
(ALPHA notation) \$ \_\_\_\_\_ (NUMERIC notation)

This bidder acknowledges receipt of the following addenda:

ADDENDUM No.: \_\_\_\_\_ Dated: \_\_\_\_\_  
ADDENDUM No.: \_\_\_\_\_ Dated: \_\_\_\_\_  
ADDENDUM No.: \_\_\_\_\_ Dated: \_\_\_\_\_

By signing below, the bidder agrees to all terms specified and AGREES TO fulfill the requirements of the CONTRACT in strict accordance with the bidding documents.

Company Name: \_\_\_\_\_

Business Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Construction Contractor  
Registration No.:

\_\_\_\_\_

Phone No.: \_\_\_\_\_

Fax No.: \_\_\_\_\_

Email: \_\_\_\_\_

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

Bid Proposals entitled to consideration shall be signed by the proper representative of the firm submitting the proposal as follows (Initial which requirement you meet):

- The principal of a single owner firm;
- A principal of a partnership firm;
- An officer of an incorporated firm, or an agent whose signature is accompanied by a certified copy of the resolution of the Board of Directors authorizing that agent to sign; or (attach a copy of the resolution),
- Other persons signing for a single-owner firm or a partnership shall attach a power-of-attorney evidencing his authority to sign for that firm.

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

Print Name: \_\_\_\_\_

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



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# GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

(Form Revision Date: November 2023)

## ARTICLE 1 – GENERAL PROVISIONS

### 1.1. BASIC DEFINITIONS

1.1.1. **CONTRACT DOCUMENTS.** The Contract Documents consist of the Contract between Owner and Contractor (hereinafter the “Contract”), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Contract and Modifications issued after execution of the Contract. A Modification is: (1) a written amendment to the Contract signed by both parties; (2) a Change Order; (3) a Construction Change Directive; or, (4) a written order for a minor change in the Work issued by the Architect/Engineer. The Contract Documents shall include the bidding documents and any alterations made thereto by addenda. In the event of a conflict, discrepancy, contradiction, or inconsistency within the Contract Documents and for the resolution of same, the following order of hierarchy and control shall apply and prevail:

1) Contract; 2) Addenda; 3) Supplementary General Conditions; 4) General Conditions; 5) Specifications; 6) Drawings; 7) Instructions to Bidders; 8) Invitation To Bid; 9) Sample Forms.

1.1.1.1. If a conflict, discrepancy, contradiction, or inconsistency occurs within or between the Specifications and the Drawings, resolution shall be controlled by the following:

1.1.1.1.1. As between figures, dimensions, or numbers given on drawings and any scaled measurements, the figures, dimensions, or numbers shall govern;

1.1.1.1.2. As between large scale drawings and small scale drawings, the larger scale drawings shall govern;

1.1.1.1.3. As between the technical specifications and drawings; the technical specifications shall govern.

1.1.1.1.4. Shop Drawings and Submittals: Shop drawings and other submittals from the Contractor, subcontractors, or suppliers do not constitute a part of the Contract Documents.

1.1.1.2. The Contractor acknowledges, understands and agrees that the Contract Documents cannot be changed except as provided herein by the terms of the Contract. No act(s), action(s), omission(s), or course of dealing(s) by the Owner or Architect/Engineer with the Contractor shall alter the requirements of the Contract Documents and that alteration can be accomplished only through a written Modification process defined herein.

1.1.2. **THE DRAWINGS.** The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, intent, location, and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

1.1.3. **THE SPECIFICATIONS.** The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

1.1.4. **THE CONTRACT.** The entire Contract for Construction is formed by the Contract Documents. The Contract represents the entire, complete, and integrated agreement between the Owner and Contractor.

hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between: (1) the Architect/Engineer and Contractor; (2) the Owner and any Subcontractor, Sub-subcontractor, or Supplier; (3) the Owner and Architect/Engineer; or, (4) between any persons or entities other than the Owner and Contractor. However, the Architect/Engineer shall at all times be permitted and entitled to performance and enforcement of its obligations under the Contract intended to facilitate performance of the Architect/Engineer's duties.

1.1.5. THE WORK. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to completely fulfill the Contract and the Contractor's obligations. The Work may constitute the whole or a part of the Project.

1.1.6. THE PROJECT. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

1.1.7. TIME. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day of a duration or time period shall be determined as the day following the current day of any event or notice starting a specified duration. All durations in the Contract Documents are calendar days unless specifically stated otherwise.

## 1.2. **CORRELATION, INTER-RELATIONSHIP, AND INTENT OF THE CONTRACT DOCUMENTS**

1.2.1. The intent of the Contract Documents is to include all items and all effort necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and inter-related, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

1.2.2. 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. It is the Contractor's responsibility to control the Work under the Contract.

1.2.3. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

## 1.3. **CAPITALIZATION**

1.3.1. Terms capitalized in these General Conditions include those which are: (1) specifically defined; and, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document.

## 1.4. **INTERPRETATION**

1.4.1. In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

## 1.5. **EXECUTION OF THE CONTRACT AND CONTRACT DOCUMENTS**

1.5.1. The Contract shall be signed by the Owner and Contractor. Execution of the Contract by the Contractor constitutes the complete and irrevocable binding of the Contractor and his Surety to the Owner for complete performance of the Work and fulfillment of all obligations. By execution of the Contract, the Contractor acknowledges that it has reviewed and familiarized itself with all aspects of the Contract Documents and agrees to be bound by the terms and conditions contained therein.

- 1.5.2. Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.
- 1.5.3. The Contractor acknowledges that it has taken all reasonable actions necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to: (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, gas, electric power, phone service, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation, topography, and conditions of the ground; and, (5) the character of equipment and facilities needed for performance of the Work. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory geotechnical work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the action described and acknowledged in this paragraph will not relieve the Contractor from responsibility for properly ascertaining and estimating the difficulty and cost of successfully performing the Work or for proceeding to successfully perform the Work without additional expense to the Owner.
- 1.5.4. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner, nor does the Owner assume responsibility for any understanding reached or representation made by any of its officers, agents, or employees concerning conditions which can affect the Work unless that understanding or representation is expressly stated in the Contract Documents.
  - 1.5.4.1. Performance of any portion of the Work beyond that required for complying with the specifications and all other requirements of the Contract, shall be deemed to be for the convenience of the Contractor and shall be at the Contractor's sole expense.
  - 1.5.4.2. There shall be no increase in the contract price or time allowed for performance which is for the convenience of the Contractor.

1.6. **OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER INSTRUMENTS OF SERVICE**

- 1.6.1. The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect/Engineer and the Architect/Engineer's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect/Engineer or the Architect/Engineer's consultants. Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights except as defined in the Owner's Contract with the Architect/Engineer. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect/Engineer upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer, and the Architect/Engineer's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect/Engineer's or Architect/Engineer's consultants' copyrights or other reserved rights.

- 1.6.2. Owner's Disclaimer of Warranty: The Owner has requested the Architect/Engineer prepare the Contract Documents for the Project which are adequate for bidding and constructing the Project. However, the Owner makes no representation, guarantee, or warranty of any nature whatsoever to the Contractor concerning such documents. The Contractor hereby acknowledges and represents that it has not, does not, and will not rely upon any such representation, guarantee, or warranty concerning the Contract Documents as no such representation, guarantee, or warranty have been or are hereby made.

## **ARTICLE 2 – THE OWNER**

### **2.1. THE STATE OF MONTANA**

- 2.1.1. The Owner is the State of Montana and is the sole entity to be identified as Owner in the Contract and as referred to throughout the Contract Documents as if singular in number.
- 2.1.2. Except as otherwise provided in Subparagraph 4.2.1, the Architect/Engineer does not have authority to bind the Owner. The observations and participations of the Owner or its authorized representative do not alleviate any responsibility on the part of the Contractor. The Owner reserves the right to observe the work and make comment. Any action or lack of action by the Owner shall not be construed as approval of the Contractor's performance.
- 2.1.3. The Owner reserves the right to require the Contractor, all sub-contractors and material suppliers to provide lien releases at any time. The Owner reserves the right to withhold progress payments until such lien releases are received for all work for which prior progress payments have been made. Upon the Owner's demand for lien releases (either verbally or written), the Contractor, all sub-contractors and material suppliers shall provide such releases with every subsequent application for payment through Final Acceptance of the Project.
- 2.1.4. Except for permits and fees, including those required under Subparagraph 3.7.1, which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.
- 2.1.5. Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness. Any other information or services relevant to the Contractor's performance of the Work under the Owner's control shall be furnished by the Owner after receipt from the Contractor of a written request for such information or services.
- 2.1.6. Unless otherwise provided in the Contract Documents, the Contractor will be furnished electronic copies of Drawings and Specifications as are reasonably necessary for execution of the Work.

### **2.2. OWNER'S RIGHT TO STOP WORK**

- 2.2.1. If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to 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 shall 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, except to the extent required by Subparagraph 6.1.3. The issuance of a stop work order by the Owner shall not give rise to a claim by the Contractor or any subcontractor for additional cost, time, or other adjustment.

### **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-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a three-day period. If the Contractor within such three-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be

issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and increased costs, and compensation for the Architect/Engineer's additional services made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

#### 2.4. **OWNER'S RIGHT TO PERSONNEL**

- 2.4.1. The Owner reserves the right to have the Contractor and/or subcontractors remove person(s) and/or personnel from any and all work on the project with cause but without cost to the Owner. Such requests from the Owner may be made verbally or in writing and may be done directly with the Contractor or indirectly through the Architect/Engineer. Cause may be, but not limited to, any of the following: incompetence, poor workmanship, poor scheduling abilities, poor coordination, disruption to the facility or others, poor management, causes delay or delays, disruption of the Project, will not strictly adhere to facility procedures and Project requirements either knowingly or unknowingly, insubordination, drug/alcohol use, possession of contraband, belligerent acts or actions, etc. The Contractor shall provide replacement person(s) and/or personnel acceptable to the Owner at no cost to the Owner.
- 2.4.2. Any issue or circumstance relating to or resulting out of this clause shall not be construed or interpreted to be interference with or impacting upon the Contractor's responsibilities and liabilities under the Contract Documents.
- 2.4.3. Person(s) and/or personnel who do not perform in accordance with the Contract Documents, shall be deemed to have provided the Owner with cause to have such persons removed from any and all involvement in the Work.
- 2.4.4. The Contractor agrees to indemnify and hold harmless the Owner from any and all causes of action, demands, claims, damages, awards, attorneys' fees, and other costs brought against the Owner and/or Architect/Engineer by any and all person(s) or personnel as a result of actions under this clause.

### **ARTICLE 3 – THE CONTRACTOR**

#### 3.1. **GENERAL**

- 3.1.1. The Contractor is the person or entity identified as such in the Contract and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.
- 3.1.2. Construction Contractor Registration: The Contractor is required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. A bidder must demonstrate that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work. If the prevailing bidder cannot or does not register in time for the Owner to execute the Contract within fifteen (15) days of the date on the notice of award, the Owner may award, at its sole discretion, to the next lowest responsible bidder who meets this requirement. The Owner will not execute a contract for construction nor issue a Notice to Proceed to a Contractor who is not registered per 39-9-401(a) MCA. It is solely the Contractor's responsibility to ensure that all Subcontractors are registered in accordance with Title 39, Chapter 9, MCA.
- 3.1.3. The Owner's engagement of the Contractor is based upon the Contractor's representations by submission of a bid to the Owner that it:
  - 3.1.3.1. has the requisite skills, judgment, capacity, expertise, and financial ability to perform the Work;
  - 3.1.3.2. is experienced in the type of labor and services the Owner is engaging the Contractor to perform;
  - 3.1.3.3. is authorized, licensed and registered to perform the type of labor and services for which it is being engaged in the State and locality in which the Project is located;

- 3.1.3.4. is qualified, willing and able to perform the labor and services for the Project in the manner and scope defined in the Contract Documents; and,
- 3.1.3.5. has the expertise and ability to provide labor and services that will meet the Owner's objectives, intent and requirements, and will comply with the requirements of all governmental, public, and quasi-public authorities and agencies having or asserting jurisdiction over the Project.
- 3.1.4. The Contractor shall perform the Work in accordance with the Contract Documents.
- 3.1.5. The Contractor shall provide on minimum of a bi-weekly basis the onsite Superintendent's daily reports/logs
- 3.1.6. The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect/Engineer in the Architect/Engineer's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.
- 3.1.7. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality control or assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.
- 3.1.8. Buy-Safe Montana Provision: The Owner shall review the Buy-Safe Montana Form provided by the Bidder under Articles 16 of the Instructions to Bidders. To promote a safe work environment, the Owner encourages an incidence rate less than the latest average for non-residential building construction for Montana as established by the federal Bureau of Labor Statistics for the prior year; an experience modification rating (EMR) less than 1.0; and a loss ratio of less than 100%. The Contractor with a greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100% shall schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before the Owner grants Substantial Completion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit <http://erd.dli.mt.gov/safety-health/onsite-consultation>.

## **3.2. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR**

- 3.2.1. Since the Contract Documents are complementary and inter-related, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions affecting the Work. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents. However, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect/Engineer as a request for information in such form as the Architect/Engineer may require.
- 3.2.2. Any errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect/Engineer, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.
- 3.2.3. If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect/Engineer in response to the Contractor's notices or requests for information pursuant to Subparagraphs 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Subparagraphs 4.3.4 and 4.3.5. If the Contractor fails to perform the obligations of Subparagraphs 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect/Engineer for damages resulting from errors, inconsistencies, or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents

unless the Contractor recognized such error, inconsistency, omission or difference and failed to report it to the Architect/Engineer.

- 3.2.4. Except as otherwise expressly provided in this Contract, the Contractor assumes all risks, liabilities, costs, and consequences of performing any effort or work in accordance with any written or oral order (including but not limited to direction, instruction, interpretation, or determination) of a person not authorized in writing by the Owner to issue such an order.
- 3.2.5. By entering into this Contract, the Contractor acknowledges that it has informed itself fully regarding the requirements of the Drawings and Specifications, the General Conditions, the Supplementary General Conditions, all other documents comprising a part of the Contract Documents and all applicable laws, building codes, ordinances and regulations. Contractor hereby expressly acknowledges, guarantees, and warrants to the Owner that:
  - 3.2.5.1. the Contract Documents are sufficient in detail and scope to enable Contractor to construct the finished project;
  - 3.2.5.2. no additional or further work should be required by Owner at the time of Owner's acceptance of the Work; and,
  - 3.2.5.3. when the Contractor's work is finished and the Owner accepts, the Work will be complete and fit for the purpose intended by the Contract Documents. This acknowledgment and guarantee does not imply that the Contractor is assuming responsibilities of the Architect/Engineer.
- 3.2.6. Sufficiency of Contract Documents: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has received, carefully reviewed, and evaluated all aspects of the Contract Documents and agrees that said Documents are adequate, consistent, coordinated, and sufficient for bidding and constructing the Work requested, intended, conceived, and contemplated therein.
  - 3.2.6.1. The Contractor further acknowledges its continuing duty to review and evaluate the Contract Documents during the performance of its services and shall immediately notify the Architect/Engineer of any problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions it discovers in the Contract Documents and the Work to be constructed; and, any variances it discovers between the Contract Documents and applicable laws, statutes, building codes, rules or regulations.
  - 3.2.6.2. If the Contractor performs any Work which it knows or should have known due to its experience, ability, qualifications, and expertise in the construction industry, that involves problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions in the Contract Documents and the Work to be constructed and, any variances between the Contract Documents and applicable laws, statutes, building codes, rules or regulations, without prior written notification to the Architect/Engineer and without prior authorization to proceed from the Architect/Engineer, the Contractor shall be responsible for and bear the costs and delays (including costs of any delay) of performing such Work and all corrective actions as directed by the Architect/Engineer.
  - 3.2.6.3. Any and all claims resulting from the Contractor's failure, including those of any subcontractor or supplier, to carefully review, evaluate, and become familiar with all aspects of the Contract Documents shall be deemed void and waived by the Contractor.
- 3.2.7. Sufficiency of Site Conditions: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has visited, carefully reviewed, evaluated, and become familiar with all aspects of the site and local conditions at which the Project is to be constructed. The Contractor agrees that the Contract Documents are an adequate, consistent, coordinated, and sufficient representation of the site and local conditions for the Work.
  - 3.2.7.1. The Contractor has reviewed and become familiar with all aspects with the Site Survey and Geotechnical Report for the Project and has a full understanding of the information provided therein.

- 3.2.7.2. If the Work involves modifications, renovations, or remodeling of an existing structure(s) or other man-made feature(s), the Contractor certifies, warrants and guarantees that it has reviewed, evaluated, and become familiar with all available as-built and record drawings, plans and specifications, and has thoroughly inspected and become familiar with the structure(s) or man-made feature(s).
- 3.2.7.3. Any and all claims resulting from the Contractor's failure, including those of any subcontractor or supplier, to visit, carefully review, evaluate, and become familiar with all aspects of the site, available geotechnical information, and local conditions at which the Project is to be constructed shall be deemed void and waived by the Contractor.

### **3.3. SUPERVISION AND CONSTRUCTION PROCEDURES**

- 3.3.1. The Contractor shall supervise and direct the Work using the Contractor's best skill and attention recognizing that time and quality are of the essence of the Work. 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, unless the Contract Documents give other specific instructions concerning these matters. It is the responsibility of and incumbent upon the Contractor to ensure, confirm, coordinate, inspect and oversee all Work (which is inclusive of but not limited to all submittals, change orders, schedules, workmanship, and appropriate staffing with enough competent and qualified personnel) so that the Work is not impacted in terms of any delays, costs, damages, or additional time, or effort on the part Architect/Engineer or Owner. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect/Engineer and shall not proceed with that portion of the Work without further written instructions from the Architect/Engineer. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Architect/Engineer or Owner as appropriate shall be solely responsible for any resulting loss or damage. The Contractor will be required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and shall propose any alternative procedure which the Contractor will warrant and guarantee. The Contractor is required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and to propose any alternative procedure which the Contractor will warrant.
- 3.3.2. The Contractor shall furnish management, supervision, coordination, labor and services that: (1) expeditiously, economically, and properly completes the Work; (2) comply with all requirements of the Contract Documents; and, (3) are performed in a quality workmanlike manner and in accordance with the standards currently practiced by persons and entities performing or providing comparable management, supervision, labor and services on projects of similar size, complexity, cost, and nature to this Project. However, the standards currently practiced within the construction industry shall not relieve the Contractor of the responsibility to perform the Work to the level of quality, detail, and excellence defined and intended by the Contract Documents as interpreted by the Architect/Engineer.
- 3.3.3. All services and labor rendered by the Contractor, including any subcontractors or suppliers, shall be performed under the immediate supervision at the site of persons possessing expertise and the requisite knowledge in the discipline or trade of service being rendered. The Contractor shall maintain such supervision and personnel at all times that the Contractor's personnel, subcontractors, and/or suppliers are at the site. The Contractor shall never be absent from the site during performance of any portion of the Work by any entity under the supervision and direction of the Contractor. Full time attendance by the Contractor from Notice to Proceed through Final Acceptance is an explicit requirement of this Contract.



- 3.3.4. The Contractor shall be responsible to the Owner for acts, damages, errors, and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.
- 3.3.5. The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

#### 3.4. **LABOR, WAGES, AND MATERIALS**

- 3.4.1. Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, permits, licenses, goods, products, equipment, tools, construction equipment and machinery, water, heat, all utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work in accordance with the Contract Documents, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.
- 3.4.2. The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order. This opportunity to request substitutions does not negate or waive any requirement for the Contractor to follow a pre-bidding "prior approval" requirement nor obligate the Owner to approve any substitution request.
- 3.4.3. The Contractor shall enforce strict discipline, appropriate behavior, and good order among the Contractor's employees, subcontractors at every tier and level, 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.
- 3.4.4. Prevailing Wages and Montana Residents.
  - 3.4.4.1. The Contractor and all subcontractors at any level or tier of the Work shall give preference to the employment of bona fide Montana residents in the performance of the Work and shall pay the standard prevailing rate of wages, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. (18-2-403, MCA)
  - 3.4.4.2. At least 50% of the workers, as defined by the Department of Labor & Industry (DOLI), must be bona fide Montana residents. (18-2-401, 18-2-402, MCA)
  - 3.4.4.3. Indian Employment Preference within the Boundaries of an Indian Reservation. All contractors that are awarded a state agency construction contract within the exterior boundaries of an Indian Reservation shall extend a hiring preference to qualified Indians as provided herein:
    - 3.4.4.3.1. "State agency" means a department, office, board, bureau, commission, agency, or other instrumentality of the executive or judicial branches of the government of this State. "Indian" means a person who is enrolled or who is a lineal descendent of a person enrolled in an enrollment listing of the Bureau of Indian Affairs or in the enrollment listing of a recognized Indian tribe domiciled in the United States.
    - 3.4.4.3.2. Qualified Indians – Employment Criteria: An Indian shall be qualified for employment in a permanent, temporary, or seasonal position if he or she has substantially equal qualifications for any position and resides on the reservation where the construction contract is to be performed.
    - 3.4.4.3.3. Non-Applicability: The Indian Employment Preference Policy does not apply to a project partially funded with federal-aid money from the United States Department of Transportation or when residency preference laws are specifically prohibited by federal law. It does not apply to independent contractors and their employees, student interns, elected officials, or appointed positions.
  - 3.4.4.4. The Commissioner of The Montana Department of Labor and Industry (DOLI) has established the standard prevailing rate of wages in accordance with 18-2-401 and 18-2-402, MCA. A copy of the Rates entitled "State of Montana, Prevailing Wage Rates" are bound herein. The Commissioner of the Montana DOLI has established the resident requirements in accordance with 18-2-409, MCA. The Contractor and all subcontractors at any level or tier of the Work

shall direct any and all questions concerning prevailing wage and Montana resident issues for all aspects of the Work to DOLI.

- 3.4.4.5. The Contractor and all subcontractors at any tier or level of the Work, and as determined by the Montana DOLI, shall classify all workers in the project in accordance with the State of Montana, Prevailing Wage Rates. In the event the Contractor is unable to classify a worker in accordance with these rates he shall contact DOLI for a determination of the classification and the prevailing wage rate to be paid.
- 3.4.4.6. The Contractor and all subcontractors at any tier or level of the Work shall be responsible for obtaining wage rates for all workers prior to their performing any work on the project. The Contractor is required to pay and insure that its subcontractors at any tier or level and others also pay the prevailing wage determined by the DOLI, insofar as required by Title 18 of the MCA and the pertinent rules and standards of DOLI.
- 3.4.4.7. It is not the responsibility of the Owner to determine who classifies as a subcontractor, sub-subcontractor, material man, supplier, or any other person involved in any aspect of the Work at any tier or level. All such determinations shall be the sole responsibility of the Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project at any tier or level. The Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project shall indemnify and hold harmless the Owner from all claims, attorneys' fees, damages and/or awards involving prevailing wage or Montana resident issues. Any changes to wages or penalties for failure to pay the correct wages will be the sole responsibility of the Contractor and/or his subcontractors and no further charges or claims shall be made to the Owner. If the parties mutually agree or an arbitrator or court determines that any change in wages is due and any part is attributable to the Owner, the Owner's sole liability shall be for the amount of wages ordered only and not for other expenses, charges, penalties, overhead, profit or other mark-ups.
- 3.4.4.8. In accordance with 18-2-422(1) MCA, each job classification's standard prevailing wage rate, including fringe benefits, that the contractors and employers shall pay during construction of the project is included herein by both reference to DOLI's "Building" or "Heavy/Highway" schedules and as part of these Contract Documents.
- 3.4.4.9. The Contractor and every employer, including all subcontractors at any tier or level, is required by 18-2-422(2) MCA to maintain payroll records in a manner readily capable of being certified for submission under 18-2-423 MCA, for a period of not less than 3 years after the contractor's, subcontractor's, or employer's completion of work on the project or the Final Acceptance by the Owner, whichever is later.
- 3.4.4.10. Each contractor is required by 18-2-422(3) MCA to post in a visible and accessible location a statement of all wages and fringe benefits in compliance with 18-2-423.
- 3.4.4.11. The contractor and all subcontractors are required by MCA 18-2-417 to make wage rate adjustments for projects with a construction duration exceeding 30 months.

### 3.5. **WARRANTY AND GUARANTEE**

- 3.5.1. The Contractor warrants to the Owner and Architect/Engineer that materials and equipment furnished under the Contract will be new and of good quality unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect/Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- 3.5.2. The Contractor shall and does hereby warrant and guarantee all work, workmanship, and materials for the full warranty period as specified in the Contract Documents. The warranty period shall be defined as

commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project by the Owner. The date of Final Acceptance shall be the date of the Architect/Engineer's signature on the final request for payment unless otherwise agreed upon in writing for the entire project or any portion thereof, by the Owner, Architect/Engineer and Contractor.

- 3.5.3. In addition to the one (1) calendar year warranty and guarantee specified in this herein above, the Contractor warrants and guarantees all materials and workmanship for the roofing system for a period of two (2) calendar years from the date of Final Acceptance. This warranty shall cover all labor and materials for roof and roofing finish systems (e.g. flashing, terminations, parapet caps, etc.) repairs from moisture penetration and/or defects in workmanship.
- 3.5.4. Manufacturer and product warranties and guarantees, as provided by the manufacturer or as specified in the Contract Documents, are in addition to the Contractor's warranty.

### 3.6. **TAXES**

- 3.6.1. The Contractor is responsible for and shall pay all sales, consumer, use, and similar taxes for the Work provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.
- 3.6.2. In compliance with 15-50-206 MCA, the Contractor will have 1% of his **gross** receipts withheld by the Owner from all payments due and sent to the Montana Department of Revenue. Each subcontractor who performs work greater than \$80,000 shall have 1% of its gross receipts withheld by the Contractor and sent to the Montana Department of Revenue. The Contractor shall notify the Department of Revenue on the Department's prescribed form.

### 3.7. **PERMITS, FEES, AND NOTICES**

- 3.7.1. Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are customarily secured after execution of the Contract, including but not limited to, the building permit fee, electrical, plumbing, sewer connection fee and mechanical permit fee, and any required impact fees and which are legally required when bids are received or negotiations concluded.
- 3.7.2. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities applicable to performance of the Work.
- 3.7.3. If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations, and does so without providing notice to the Architect/Engineer and Owner, the Contractor shall assume responsibility for such Work and shall bear the costs attributable to correction. The Contractor shall be solely responsible to insure that all work it performs is in full compliance with all prevailing and applicable codes and regulations.
- 3.7.4. Incident Reporting: The Contractor shall immediately notify the Owner and Architect/Engineer, both orally and in writing, of the nature and details of all incidents which may adversely affect the quality or progress of the Work, including, but not limited to, union disputes, accidents, delays, damages to Work, and other significant occurrences. Such notices are in addition to any other notices required regarding claims.

### 3.8. **ALLOWANCES**

- 3.8.1. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.
- 3.8.2. Unless otherwise provided in the Contract Documents:
  - 3.8.2.1. allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

3.8.2.2. Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included by the Contractor in the Contract Sum but not in the allowances;

3.8.2.3. whenever costs are more than or less than stated allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect: (1) the difference between actual costs and the allowances under Clause 3.8.2.1; and, (2) changes in Contractor's costs under Clause 3.8.2.2.

3.8.3. Materials and equipment under an allowance shall be selected by the Owner.

### 3.9. **CONTRACTOR'S PERSONNEL**

3.9.1. The Contractor shall employ competent personnel, supervisors, project managers, project engineers, project superintendent, and all others who shall be assigned to the Work throughout its duration. Contractor's personnel extend to those employed by the Contractor whether at the site or not. The Owner shall have right to review and approve or reject all replacement of Contractor's personnel. All personnel assigned by the Contractor to the Work shall possess the requisite experience, skills, abilities, knowledge, and integrity to perform the Work.

3.9.2. The superintendent and others as assigned shall be in attendance at the Project site during the performance of any and all Work. The superintendent shall represent the Contractor. All communications given to the Contractor's personnel such as the project manager or the superintendent, whether verbal, electronic or written, shall be as binding as if given to the Contractor.

3.9.3. It is the Contractor's responsibility to appropriately staff, manage, supervise and direct the Work which is inclusive of the performance, acts, and actions of his personnel and subcontractors. As such, the Contractor further agrees to indemnify and hold harmless the Owner and the Architect/Engineer, and to protect and defend both from and against all claims, attorneys' fees, demands, causes of action of any kind or character, including the cost of defense thereof, arising in favor of or against the Owner, Architect/Engineer, Contractor, their agents, employees, or any third parties on account of the performance, behavior, acts or actions of the Contractor's personnel or subcontractors.

3.9.4. Prior to the commencement of any work, the Contractor shall prepare and submit a personnel listing and organizational chart in a format acceptable to the Owner which lists by name, phone number (including cell phone), job category, and responsibility the Contractor's key/primary personnel who will work on the Project. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference.

3.9.5. The Contractor shall immediately remove for the duration of the Project, any person making an inappropriate racial, sexual, or ethnic comment, statement, joke, or gesture toward any other individual.

3.9.6. The Contractor shall immediately remove for the duration of the Project, any person who is incompetent, careless, disruptive, or not working in harmony with others.

### 3.10. **CONSTRUCTION SCHEDULES**

3.10.1. The Contractor shall, promptly after being awarded the Contract, prepare and submit for the Owner's and Architect/Engineer's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and per the requirements of the Contract Documents, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor's schedule shall be in the "Critical Path Method" and shall show the Critical Path of the Work in sufficient detail to evaluate the Contractor's progress. A request for time extension by the Contractor will not be allowed unless a change in the Work is approved by the Owner and materially affects the Critical Path. It is the Contractor's responsibility to demonstrate that any time extensions requests materially affect the Critical Path.

- 3.10.2. The Contractor shall prepare and keep current, for the Architect/Engineer's approval, a schedule of submittals which is coordinated with the Contractor's Construction Schedule and allows the Architect/Engineer reasonable time to review submittals.
- 3.10.3. The Contractor shall perform the Work in accordance with the most recent schedule submitted to the Owner and Architect/Engineer.
- 3.10.4. The Contractor's operations (including but not limited to the Contractor's forces employed, sequences of operations, and methods of operation) at all times during the performance of the contract shall be: (a) subject to the review of the Owner or the Architect/Engineer; and, (b) sufficient to insure the completion of the Work within the specified performance period.
- 3.10.5. The Critical Path Method Construction Schedule prepared by the Contractor must be in a form that is acceptable to both the Architect/Engineer and the Owner.
  - 3.10.5.1. The Schedule shall show the estimated progress of the entire Project through the individual time periods allowed for completion of each discipline, trade, phase, section, and aspect of the Work.
  - 3.10.5.2. The Schedule shall show percent complete, progress to date, project work, and projected time to complete the work for all activities. The percent complete and minor schedule changes, including additions of activities, change orders, construction change directives, changes to sequences of activities and significant changes in activity demands must be shown by a revised Schedule. A written report providing details about the changes and what actions are anticipated to get the work completed in the contractual time period shall be submitted with the revised schedule.
  - 3.10.5.3. The Construction Schedule shall include coordinate dates for performance of all divisions of the Work, including shipping and delivery, off-site requirements and tasks, so the Work can be completed in a timely and orderly fashion consistent with the required dates of Substantial Completion and Final Acceptance.
  - 3.10.5.4. The Construction Schedule shall include: (i) the required commencement date, the required dates of Substantial Completion(s) and Final Acceptance for the complete Project and all phases (if any); (ii) any guideline and milestone dates required by the Owner or the Contract Documents; (iii) subcontractor and supplier schedules; (iv) a submittal schedule which allows sufficient time for review and action by the Architect/Engineer; (v) the complete sequence of all construction activities with start and completion dates; and, (vi) required decision dates.
  - 3.10.5.5. By receiving, reviewing, and/or commenting on the Construction Schedule or any portion thereof (including logic and resource loading), neither the Owner or Architect/Engineer assume any of the Contractor's responsibility or liability that the Schedule be coordinated or complete, or for timely and orderly completion of the Work.
  - 3.10.5.6. Receiving, reviewing, and/or commenting on the Schedule, any portion thereof, or any revision thereof, does not constitute an approval, acknowledgement, or acceptance of any duration, dates, milestones, or performance indicated therein.
  - 3.10.5.7. A printout of the Schedule's logic showing all activities is required with the Schedule and with all updates to the Schedule.
- 3.10.6. The Contractor shall review and compare, at a minimum on a weekly basis, the actual status of the Work against its Construction Schedule.
- 3.10.7. The Contractor shall routinely, frequently, and periodically (but not less than monthly) update and/or revise its Construction Schedule to show actual progress of the Work through the date of the update or revision, projected level of completion of each remaining activity, activities modified since the previous update or revision, and major changes in scope or logic. The updated/revised Schedule shall be accompanied by a narrative report which: (1) states and explains any modifications of the critical path, if

any, including any changes in logic; (2) defines problem areas and lists areas of anticipated delays; (3) explains the anticipated impact the change in the critical path or problems and delays will have on the entire Schedule and the completion of the Work; (4) provides corrective action taken or proposed; and, (5) states how problems or delays will be resolved in order to deliver the Work by the required phasing milestones (if any), Substantial Completion(s), and Final Acceptance dates.

- 3.10.8. Delay in Performance: If at any time the Contractor anticipates that performance of the Work will be delayed or has been delayed, the Contractor shall: (1) immediately notify the Architect/Engineer by separate and distinct correspondence of the probable cause and effect of the delay, and possible alternatives to minimize the delay; and, (2) take all corrective action reasonably necessary to deliver the Work by the required dates. Nothing in this paragraph or the Contract Documents shall be construed by the Contractor as a granting by the Architect/Engineer or Owner of constructive acceleration. The results of failure to anticipate delays, or to timely notify the Owner and Architect/Engineer of an anticipated or real delay, are entirely the responsibility of the Contractor whether compensable or not.
- 3.10.9. Early Completion: The Contractor may attempt to achieve Substantial Completion(s) on or before the date(s) required in the Contract. However, such early completion shall be for the Contractor's sole convenience and shall not create any real or implied additional rights to Contractor or impose any additional obligations on the Owner or Architect/Engineer. The Owner will not be liable for nor pay any additional compensation of any kind to the Contractor for achieving Substantial Completion(s) or Final Acceptance prior to the required dates as set forth in the Contract. The Owner will not be liable for nor pay any additional compensation of any kind should there be any cause whatsoever that the Contractor is not able to achieve Substantial Completion(s) earlier than the contractually required dates of Substantial Completion(s) or Final Acceptance.
- 3.10.10. Float in Schedule. Any and all float time in the Contractor's schedule, regardless of the path or activity, shall accrue to the benefit of the Owner and the Work, and not to the Contractor. Float also includes any difference shown between any early completion dates shown on the Contractor's Schedule for any phasing milestone(s), Substantial Completion(s) or Final Acceptance and the dates or durations as required by the Contract Documents.
- 3.10.11. Modification of Required Substantial Completion(s) or Final Acceptance Dates: Modification of the required dates shall be accomplished only by duly authorized, accepted, and approved change orders stating the new date(s) with specificity on the change order form. All rights, duties, and obligations, including but not limited to the Contractor's liability for actual, delay, and/or liquidated damages, shall be determined in relation to the date(s) as modified.

### 3.11. **DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE**

- 3.11.1. The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and accurately marked to record current field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect/Engineer or Owner at any time and shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work.
- 3.11.2. The Owner shall not be required to process final payment until all documentation and data required by the Contract Documents is submitted to and approved by the Architect/Engineer including, but not limited to, the As-Built Drawings. The Owner will not process any final request for payment until the Architect/Engineer has received and verified that the Contractor has performed the requirements pertaining to the as-built drawings.
- 3.11.3. The as-built drawings shall be neatly and clearly marked during construction to record all deviations, variations, changes, and alterations as they occur during construction along with such supplementary notes and details necessary to clearly and accurately represent the as-built condition. The as-built drawings shall be available at all times to the Owner, Architect/Engineer and Architect/Engineer's consultants.

### 3.12. **SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

3.12.1. Definitions:

3.12.1.1. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

3.12.1.2. 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.

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

3.12.2. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect/Engineer is subject to the limitations of Subparagraph 4.2.7. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

3.12.3. The Contractor shall review, approve, and submit to the Architect/Engineer, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents within sixty (60) calendar days of being issued the Notice To Proceed unless noted otherwise and shall do so in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Any and all items submitted by the Contractor which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor, or in the opinion of the Architect/Engineer, have not been reviewed for compliance by the Contractor even if marked as such, may be returned by the Architect/Engineer without action and shall not result in any accusation or claim for delay or cost by the Contractor. Any submittal that, in the opinion of the Architect/Engineer, is incomplete in any area or detail may be rejected and returned to the Contractor. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all submittals are complete, accurate, and in conformance to the Contract Documents prior to submission.

3.12.4. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents and guarantees to the Architect/Engineer and Owner that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

3.12.5. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer. Should the Contractor, Subcontractors or Sub-subcontractors install, construct, erect or perform any portion of the Work without approval of any requisite submittal, the Contractor shall bear the costs, responsibility, and delay for removal, replacement, and/or correction of any and all items, material, and /or labor.

3.12.6. The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and: (1) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work; or, (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's approval thereof.

3.12.7. The Contractor shall direct specific attention, in writing or on re-submitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect/Engineer on previous submittals. In the absence of such written notice the Architect/Engineer's approval of a re-submission shall not apply to such revisions.

- 3.12.8. The Contractor shall not be required to provide professional services which constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect/Engineer will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect/Engineer. The Owner and the Architect/Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided the Owner and Architect/Engineer have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this subparagraph, the Architect/Engineer will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents but shall be responsible and held liable for review and verification of all performance or design criteria as required by Paragraph 3.2.
- 3.12.9. Unless noted otherwise in the Contract Documents, the Contractor shall submit to the Architect/Engineer within sixty (60) days from the date of the Notice To Proceed electronic copies of all shop/setting drawings, schedules, cut sheets, products, product data, and samples required for the complete Work. Copies shall be reviewed, marked, stamped and approved on each and every copy by the Contractor prior to submission to the Architect/Engineer or they shall be returned without review or action. The Architect/Engineer shall review with reasonable promptness, making corrections, rejections, or other actions as appropriate. The Architect/Engineer's approval or actions on shop/setting drawings, schedules, cut sheets, products, product data, or samples shall not relieve the Contractor from responsibility for, nor deviating from, the requirements of the plans and specifications. Any deviations from the plans and specifications requested or made by the Contractor shall be brought promptly to the attention of the Architect/Engineer.
- 3.12.10. Cost for Re-Submissions: the Contractor is responsible for ensuring that all shop drawings, product data, samples, and submittals contain all information required by the Contract Documents to allow the Architect/Engineer to take action. The costs and expenses to the Architect/Engineer for making exhaustive reviews of each Shop Drawing, Product Data item, sample, or submittal of the Contractor may be billed by the Architect/Engineer directly to the Contractor or, if otherwise agreed by the Owner in writing, may be reimbursed by the Owner to the Architect/Engineer and deducted from the Contractor's contract via change order by the Owner. The Owner will not be liable to the Architect/Engineer for multiple reviews.

### 3.13. **USE OF SITE**

- 3.13.1. The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.
- 3.13.2. The Contractor shall not damage, endanger, compromise or destroy any part of the Project or the site, including but not limited to work performed by others, monuments, stakes, bench marks, survey points, utilities, existing features or structures. The Contractor shall be fully and exclusively responsible for and bear all costs and delays (including and costs of delay) for any damage, endangerment, compromise, or destruction of any part of the Project or site.

### 3.14. **CUTTING AND PATCHING**



- 3.14.1. The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.
- 3.14.2. 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.

### 3.15. **CLEAN UP AND SITE CONTROL**

- 3.15.1. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract during performance of the Work and at the direction of the Owner or Architect/Engineer. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.
- 3.15.2. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

### 3.16. **ACCESS TO WORK**

- 3.16.1. The Contractor shall provide the Owner and Architect/Engineer access to the Work at all times wherever located.

### 3.17. **ROYALTIES, PATENTS AND COPYRIGHTS**

- 3.17.1. The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect/Engineer harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect/Engineer. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect/Engineer.

### 3.18. **INDEMNIFICATION**

- 3.18.1. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, 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 a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph. The Contractor agrees that it will defend, protect, indemnify and save harmless the State of Montana and the Owner against and from all claims, liabilities, demands, causes of action, judgments (including costs and reasonable attorneys' fees), and losses from any cause whatever (including patent, trademark and copyright infringement) except the Owner's sole or partial negligence. This includes any suits, claims, actions, losses, costs, damages of any kind, including the State and Owner's legal expenses, arising out of, in connection with, or incidental to the Contract, but does not include any such suits, claims, actions, losses, costs or damages which are the result of the negligent acts, actions, losses, costs, or damages which are acts, omissions or misconduct of the Owner if they do not arise out of, depend upon or relate to a negligent act, omission or misconduct of the Contractor in whole or in part.
- 3.18.2. In claims against any person or entity indemnified under this Paragraph 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts

they may be liable, the indemnification obligation under Subparagraph 3.18.1 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 under workers' compensation acts, disability benefit acts or other employee benefit acts.

#### **ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT**

##### **4.1. THE ARCHITECT/ENGINEER**

- 4.1.1. The Architect/Engineer is the person lawfully licensed to practice or an entity lawfully practicing identified as such in the Agreement with the Owner and is referred to throughout the Contract Documents as if singular in number. The term "Architect/Engineer" means the Architect/Engineer's duly authorized representative.
- 4.1.2. Duties, responsibilities and limitations of authority of the Architect/Engineer as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner.
- 4.1.3. If the employment of the Architect/Engineer is terminated, the Owner shall employ a new Architect/Engineer at the sole choice and discretion of the Owner, whose status under the Contract Documents shall be that of the former Architect/Engineer.

##### **4.2. ARCHITECT/ENGINEER'S ADMINISTRATION OF THE CONSTRUCTION CONTRACT**

- 4.2.1. The Architect/Engineer will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative throughout the complete duration of the Project, including the warranty period. The Architect/Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with the Architect/Engineer Contract.
- 4.2.2. The Architect/Engineer, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations to: (1) become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed; (2) endeavor to guard the Owner against defects and deficiencies in the Work; and, (3) to determine in general if the Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Owner and Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Contractor's Work. The Owner and Architect/Engineer will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, for the safety of any person involved in the work, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.
- 4.2.3. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.
- 4.2.4. Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect/Engineer about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor to the Architect/Engineer. Communications by and with separate contractors shall be through the Owner to the Architect/Engineer.
- 4.2.5. Based on the Architect/Engineer's evaluations of the Contractor's Applications for Payment, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts. The Contractor is fully aware that the Owner (i.e. the State of Montana) has established a billing cycle for processing payments in Article 9 of these General Conditions. The Contractor and all Subcontractors are subject to all provisions of Title 28, Chapter 2, Part 21 MCA regarding all aspects of the Work.

- 4.2.6. The Architect/Engineer will have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect/Engineer considers it necessary or advisable, the Architect/Engineer will have authority to require inspection or testing of the Work in accordance with the General Conditions and any applicable technical specification requirements, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect/Engineer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect/Engineer to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.
- 4.2.7. The Architect/Engineer will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect/Engineer's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect/Engineer's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5 and 3.12. The Architect/Engineer's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.
- 4.2.8. The Architect/Engineer will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.
- 4.2.9. The Architect/Engineer will conduct inspections to determine the date or dates of Substantial Completion(s) and the date of Final Acceptance, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.
- 4.2.10. If the Owner and Architect/Engineer agree, the Architect/Engineer will provide one or more project representatives to assist in carrying out the Architect/Engineer's responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in the Owner's Agreement with the Architect/Engineer.
- 4.2.11. The Architect/Engineer will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect/Engineer shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect/Engineer to furnish such interpretations until 15 days after written request is made for them.
- 4.2.12. Interpretations and decisions of the Architect/Engineer will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and initial decisions, the Architect/Engineer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will render such interpretations and decisions in good faith.
- 4.2.13. The Architect/Engineer's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.
- 4.2.14. The Architect/Engineer's or Owner's observations or inspections do not alleviate any responsibility on the part of the Contractor. The Architect/Engineer and the Owner reserves the right to observe and inspection

the work and make comment. Action or lack of action following observation or inspection is not to be construed as approval of Contractor's performance.

#### 4.3. **CLAIMS AND DISPUTES**

4.3.1. Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extensions of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes, controversies, and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest solely with the party making the Claim.

4.3.1.1. Time Limits on Claims. Claims by either party must be initiated within 21 calendar days after occurrence of the event giving rise to such claim. The following shall apply to the initiation of a claim:

4.3.1.1.1. A written notice of a claim must be provided to the Architect/Engineer and the other party within 21 calendar days after the occurrence of the event or the claim is waived by the claiming party and void in its entirety.

4.3.1.1.2. Claims must be initiated by separate, clear, and distinct written notice within the 21 calendar day time frame to the Architect/Engineer and the other party and must contain the notarized statement in Sub-Paragraph 4.3.1.5 when the claim is made by the Contractor. Discussions in any form with the Architect/Engineer or Owner, whether at the site or not, do not constitute initiation of a claim. Notes in project meeting minutes, email correspondence, change order proposals, or any other form of documentation does not constitute initiation of a claim. The written notice must be a separate and distinct correspondence provided in hardcopy to both the Architect/Engineer and Owner and must delineate the specific event and outline the causes and reasons for the claim whether or not cost or time have been fully determined. Written remarks or notes of a generic nature are invalid in their entirety. Comments made at progress meetings, project site visits, inspections, emails, voice mails, and other such communications do not meet the requirement of providing notice of claim.

4.3.1.1.3. Physical Injury or Physical Damage. Should the Owner or Contractor suffer physical injury or physical damage to person or property because of any error, omission, or act of the other party or others for whose acts the other party is legally and contractually liable, claim will be made in writing to the other party within a reasonable time of the first observance of such physical injury or physical damage but in no case beyond 30 calendar days of the first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose. In all such cases, the indemnification provisions of the Contract shall be effectual and the Contractor's insurance shall be primary and in full effect.

4.3.1.2. All Claims must contain sufficient justification and substantiation with the written notice or they may be rejected without consideration by the Architect/Engineer or other party with no additional impact or consequence to the Contract Sum, Contract Time, or matter(s) in question in the Claim.

4.3.1.3. If additional compensation is claimed, the exact amount claimed and a breakdown of that amount into the following categories shall be provided with each and every claim:

4.3.1.3.1. Direct costs (as listed in Subparagraph 7.3.9.1 through 7.3.9.5);

4.3.1.3.2. Indirect costs (as defined in Paragraph 7.2.5); and,

4.3.1.3.3. Consequential items (i.e. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution) for the change.

4.3.1.4. If additional time is claimed the following shall be provided with each and every claim:

- 4.3.1.4.1. The specific number of days and specific dates for which the additional time is sought;
- 4.3.1.4.2. The specific reasons, causes, and/or effects whereby the Contractor believes that additional time should be granted; and,
- 4.3.1.4.3. The Contractor shall provide analyses, documentation, and justification of its claim for additional time in accordance with the latest Critical Path Method schedule in use at the time of event giving rise to the claim.

4.3.1.5. With each and every claim, the Contractor shall submit to the Architect/Engineer and Owner a notarized statement containing the following language:

"Under penalty of law (including perjury and/or false/fraudulent claims against the State), the undersigned,

(Name)	(Title)
Of (Company)	(Date)

hereby certifies, warrants, and guarantees that this claim made for Work on this Contract is a true statement of the costs, adjustments and/or time sought and is fully documented and supported under the contract between the parties.

(Signature)	(Date)"
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4.3.2. Continuing Contract Performance.

4.3.2.1. Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Subparagraph 9.7.1 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents on the portion of the Work not involved in a Claim.

4.3.3. Claims for Cost or Time for Concealed or Unknown Conditions.

4.3.3.1. 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 observing party shall be given to the other party promptly before conditions are disturbed.

4.3.3.2. The Architect/Engineer will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer 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 Architect/Engineer shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the date of the Architect/Engineer's decision.

4.3.3.3. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect/Engineer for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

4.3.3.4. Nothing in this paragraph shall relieve the Contractor of its obligation to adequately and sufficiently investigate, research, and examine the site, the site survey, topographical

information, and the geotechnical information available whether included by reference or fully incorporated in the Contract Documents.

#### 4.3.4. Claims for Additional Cost.

4.3.4.1. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.6.

4.3.4.2. If the Contractor believes additional cost is involved for reasons including but not limited to: (1) a written interpretation from the Architect/Engineer; (2) an order by the Owner to stop the Work solely for the Owner's convenience or where the Contractor was not at least partially at fault; (3) a written order for a minor change in the Work issued by the Architect/Engineer; (4) failure of payment by the Owner per the terms of the Contract; (5) termination of the Contract by the Owner; or, (6) other reasonable grounds, Claim must be filed in accordance with this Paragraph 4.3.

#### 4.3.5. Claims for Additional Time

4.3.5.1. If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as specified in these General Conditions shall be provided along with the notarized certification. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay for the same event or cause only one Claim is necessary. However, separate and distinct written notice is required for each separate event.

#### 4.3.5.2. Weather Delays:

4.3.5.2.1. If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction activities.

4.3.5.2.2. Inclement or adverse weather shall not be a prima facie reason for the granting of an extension of time, and the Contractor shall make every effort to continue work under prevailing conditions. The Owner may grant an extension of time if an unavoidable delay occurs as a result of inclement/severe/adverse weather and such shall then be classified as a "Delay Day". Any and all delay days granted by the Owner are and shall be non-compensable in any manner or form. The Contractor shall comply with the notice requirements concerning instances of inclement/severe/adverse weather before the Owner will consider a time extension. Each day of inclement/severe/adverse weather shall be considered a separate instance or event and as such, shall be subject to the notice requirements.

4.3.5.2.3. An "inclement", "severe", or "adverse" weather delay day is defined as a day on which the Contractor is prevented by weather or conditions caused by weather resulting immediately there from, which directly impact the current controlling critical-path operation or operations, and which prevent the Contractor from proceeding with at least 75% of the normal labor and equipment force engaged on such critical path operation or operations for at least 60% of the total daily time being currently spent on the controlling operation or operations.

4.3.5.2.4. The Contractor shall consider normal/typical/seasonal weather days and conditions caused by normal/typical/seasonal weather days for the location of the Work in the planning and scheduling of the Work to ensure completion within the Contract Time. No time extensions will be granted for the Contractor's failure to consider and account for such weather days and conditions caused by such weather for the Contract Time in which the Work is to be accomplished.

4.3.5.2.5. A "normal", "typical", or "seasonal" weather day shall be defined as weather that can be reasonably anticipated to occur at the location of the Work for each particular month involved in the Contract Time. Each month involved shall not be

considered individually as it relates to claims for additional time due to inclement/adverse/severe weather but shall consider the entire Contract Time as it compares to normal/typical/seasonal weather that is reasonably anticipated to occur. Normal/typical/seasonal weather days shall be based upon U.S. National Weather Service climatic data for the location of the Work or the nearest location where such data is available.

4.3.5.2.6. The Contractor is solely responsible to document, prepare and present all data and justification for claiming a weather delay day. Any and all claims for weather delay days shall be tied directly to the current critical-path operation or operations on the day of the instance or event which shall be delineated and described on the Critical-Path Schedule and shall be provided with any and all claims. The Contractor is solely responsible to indicate and document why the weather delay day(s) claimed are beyond those weather days which are reasonably anticipated to occur for the Contract Time. Incomplete or inaccurate claims, as determined by the Architect/Engineer or Owner, may be returned without consideration or comment.

4.3.5.3. Where the Contractor is prevented from completing any part of the Work with specified durations or phases due to delay beyond the control of both the Owner and the Contractor, an extension of the contract time or phase duration in an equal amount to the time lost due to such delay shall be the Contractor's sole and exclusive remedy for such delay.

4.3.5.4. Delays attributable to and/or within the control of subcontractors and suppliers are deemed to be within the control of the Contractor.

4.3.5.5. In no event shall the Owner be liable to the Contractor, any subcontractor, any supplier, Contractor's surety, or any other person or organization, for damages or costs arising out of or resulting from: (1) delays caused by or within the control of the Contractor which include but are not limited to labor issues or labor strikes on the Project, federal, state, or local jurisdiction enforcement actions related directly to the Contractor's Work (e.g. safety or code violations, etc.); or, (2) delays beyond the control of both parties including but not limited to fires, floods, earthquakes, abnormal weather conditions, acts of God, nationwide material shortages, actions or inaction by utility owners, emergency declarations by federal, state, or local officials enacted in the immediate vicinity of the project, or other contractors performing work for the Owner.

#### 4.3.6. Claims for Consequential Damages

4.3.6.1. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:

4.3.6.1.1. damages incurred by the Owner for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and,

4.3.6.1.2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, income, and for loss of profit.

4.3.6.2. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this waiver of consequential damages shall be deemed to preclude an award of liquidated or actual damages, when applicable, in accordance with the requirements of the Contract Documents.

#### 4.4. **RESOLUTION OF CLAIMS, DISPUTES, AND CONTROVERSIES**

4.4.1. Decision of Architect/Engineer. Claims, including those alleging an error or omission by the Architect/Engineer, shall be referred initially to the Architect/Engineer for decision. A decision by the Architect/Engineer shall be required as a condition precedent to mediation, arbitration or litigation of all Claims between the Contractor and Owner arising prior to the date of Final Acceptance, unless 30 days have passed after the Claim has been referred to the Architect/Engineer with no decision having been rendered by the Architect/Engineer. The Architect/Engineer will not decide disputes between the

Contractor and persons or entities other than the Owner. Any Claim arising out of or related to the Contract, except those already waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, pending compliance with Subparagraph 4.4.5, be subject to mediation, arbitration, or the institution of legal or equitable proceedings. Claims waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4, and 9.10.5 are deemed settled, resolved, and completed.

- 4.4.2. The Architect/Engineer will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party; (2) reject the Claim in whole or in part; (3) approve the Claim; (4) suggest a compromise; or (5) advise the parties that the Architect/Engineer is unable to resolve the Claim if the Architect/Engineer lacks sufficient information to evaluate the merits of the Claim or if the Architect/Engineer concludes that, in the Architect/Engineer's sole discretion, it would be inappropriate for the Architect/Engineer to resolve the Claim.
- 4.4.3. If the Architect/Engineer requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond within ten (10) days after receipt of such request and shall either provide a response on the requested supporting data, advise the Architect/Engineer when the response or supporting data will be furnished, or advise the Architect/Engineer that no supporting data will be furnished. Upon either no response or receipt of the response or supporting data, the Architect/Engineer will either reject or approve the Claim in whole or in part.
- 4.4.4. The Architect/Engineer will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect/Engineer shall be final and binding on the parties but subject to mediation and arbitration.
- 4.4.5. When 30 days have passed upon submission of a Claim without decision or action by the Architect/Engineer, or the Architect/Engineer has rendered a decision or taken any of the actions identified in Subparagraph 4.4.2, a demand for arbitration of a Claim covered by such decision or action must be made within 30 days after the date of expiration of Subparagraph 4.4.1 or within 30 days of the Architect/Engineer's decision or action. Failure to demand arbitration within said 30 day period shall result in the Architect/Engineer's decision becoming final and binding upon the Owner and Contractor whenever such decision is rendered.
- 4.4.6. If the Architect/Engineer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.
- 4.4.7. Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.
- 4.4.8. A Claim subject to or related to liens or bonds shall be governed by applicable law regarding notices, filing deadlines, and resolution of such Claim prior to any resolution of such Claim by the Architect/Engineer, by mediation, or by arbitration, except for claims made by the Owner against the Contractor's bonds.

#### 4.5. **MEDIATION**

- 4.5.1. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, after initial decision by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.
- 4.5.2. The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect and/or those rules specified in the contract documents or separately agreed upon between the parties. Construction Industry Mediation Rule M-2 (filing with AAA)



is void. The parties shall mutually agree upon a mediator who shall then take the place of AAA in the Construction Industry Mediation Rules. The parties must mutually agree to use AAA and no filing of a request for mediation shall be made to AAA by either party until such mutual agreement has been made. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

4.5.3. The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

#### 4.6. **ARBITRATION**

4.6.1. Any controversy or Claim arising out of or related to this Contract or the breach thereof shall be settled by arbitration in accordance with the Montana Uniform Arbitration Act (MUAA). To the extent it does not conflict with the MUAA, the Construction Industry Arbitration Rules of the American Arbitration Association shall apply except as modified herein. The parties to the arbitration shall bear their own costs and expenses for participating in the arbitration. Costs of the Arbitration panel shall be borne equally between the parties except those costs awarded by the Arbitration panel (including costs for the arbitration itself).

4.6.2. Prior to the arbitration hearing all parties to the arbitration may conduct discovery subject to the provisions of Montana Rules of Civil Procedure. The arbitration panel may award actual damages incurred if a party fails to provide full disclosure under any discovery request. If a party claims a right of information privilege protected by law, the party must submit that claim to the arbitration panel for a ruling, before failing to provide information requested under discovery or the arbitration panel may award actual damages.

4.6.3. The venue for all arbitration proceedings required by this Contract shall be the seat of the county in which the work occurs or the First Judicial District, Lewis & Clack County, as determined solely by the Owner. Arbitration shall be conducted by a panel comprised of three members with one selected by the Contractor, one selected by the Owner, and one selected by mutual agreement of the Owner and the Contractor.

4.6.4. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5, shall, after decision or action by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to arbitration provided a demand for arbitration is made within the time frame provided in Subparagraph 4.4.5. If such demand is not made with the specified time frame, the Architect/Engineer's decision or action is final. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Paragraph 4.5.

4.6.5. Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect and/or those rules specified in the Contract Documents or separately agreed upon between the parties. Construction Industry Arbitration Rule R-3 (filing with AAA) is void. The parties shall mutually agree upon an arbitrator or arbitrators who shall then take the place of AAA in the Construction Industry Arbitration Rules. The parties must mutually agree to use AAA and no filing of a demand for arbitration shall be made to AAA by either party until such mutual agreement has been made. The demand for arbitration shall be filed in writing with the other party to the Contract and a copy shall be filed with the Architect/Engineer.

4.6.6. A demand for arbitration shall be made within the time limits specified in Subparagraphs 4.4.5 and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 13.7.

4.6.7. Pending final resolution of a Claim including arbitration, unless otherwise mutually agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract on Work or amounts not in dispute.

- 4.6.8. **Limitation on Consolidation or Joinder.** Arbitration arising out of or relating to the Contract may include by consolidation or joinder the Architect/Engineer, the Architect/Engineer's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Architect/Engineer, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Architect/Engineer, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Architect/Engineer, Contractor or a separate contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.
- 4.6.9. **Claims and Timely Assertion of Claims.** The party filing a demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.
- 4.6.10. **Judgment on Final Award.** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof. The parties agree that the costs of the arbitrator(s)' compensation and expenses shall be borne equally. The parties further agree that the arbitrator(s) shall have authority to award to either party some or all of the costs and expenses involved, including attorney's fees.

## **ARTICLE 5 – SUBCONTRACTORS**

### **5.1. DEFINITIONS**

- 5.1.1. A Subcontractor is a person or entity who has a direct or indirect contract at any tier or level with the Contractor or any Subcontractor to the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

### **5.2. AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK**

- 5.2.1. Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract and in no instance later than (30) days after award of the Contract, shall furnish in writing to the Owner through the Architect/Engineer the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect/Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect/Engineer, after due investigation, has reasonable objection to any such proposed person or entity.
- 5.2.2. The Contractor shall not contract with a proposed person or entity to which the Owner or Architect/Engineer has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.
- 5.2.3. If the Owner or Architect/Engineer has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect/Engineer has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.
- 5.2.4. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect/Engineer makes reasonable objection to such substitute. The Contractor shall not change or

substitute for a Subcontractor who was required to be listed on the bid without first getting the approval of the Owner.

- 5.2.5. Buy-Safe Montana Provision: Before commencement of each subcontractor's portion of the Work, the Contractor shall obtain each subcontractor's incidence rate, experience modification rate, and loss ratio. The Contractor shall endeavor--but is not required--to use subcontractors whose incidence rate is less than the latest average for non-residential building construction for Montana as established by the Federal Bureau of Labor Statistics for the prior year; whose experience modification rating (EMR) is less than 1.0; and whose loss ratio is less than 100%. Contractor shall require any of its subcontractors who, based on the safety information that the Contractor obtains, have greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100%, to schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before substantial completion of each such subcontractor's portion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit <http://erd.dli.mt.gov/safety-health/onsite-consultation>.

### 5.3. **SUBCONTRACTUAL RELATIONS**

- 5.3.1. By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect/Engineer. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect/Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, 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 Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.
- 5.3.2. Upon written request by the Owner, the Contractor shall require its subcontractors to provide to it performance and payment securities for their portion of the Work in the types and form defined in statute (18-2-201 and 18-2-203 MCA) for all sub-contractual agreements.
- 5.3.3. The Contractor shall prepare a Subcontractors' and Suppliers' chart in CSI division format acceptable to the Owner which lists by name, all contact information, job category, and responsibility the Contractor's Subcontractors (at all tiers or levels) and Suppliers with a pecuniary interest in the Project of greater than \$5,000.00. The Contractor shall not enter into any agreement with any subcontractor or supplier to which the Owner raises a timely objection. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference but no less than 30 days after award of the Contract.
- 5.3.4. All Contractors and Subcontractors to this contract must comply with all Montana Department of Labor and Industry requirements, regulations, rules, and statutes.
- 5.3.5. In accordance with 39-51-1104 MCA, any Contractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, who contracts with any Subcontractor who also is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, shall withhold sufficient money on the contract to guarantee that all taxes, penalties, and interest are paid upon completion of the contract.

5.3.5.1. It is the duty of any Subcontractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, to furnish the Contractor with a certification issued by the Montana Department of Labor and Industry, prior to final payment stating that said Subcontractor is current and in full compliance with the provisions of Montana Department of Labor and Industry.

5.3.5.2. Failure to comply shall render the Contractor directly liable for all taxes, penalties, and interest due from the Subcontractor, and the Montana Department of Labor and Industry has all of the remedies of collection against the Contractor under the provisions of Title 39, Chapter 51 of Montana Code Annotated, as though the services in question were performed directly for the Contractor.

5.3.6. In compliance with state statutes (15-50-206 MCA), the Contractor will have the 1% Gross Receipts Tax withheld from all payments. Each "Public Contractor" includes all Subcontractors with contracts greater than \$80,000 each. The Contractor and all Subcontractors will withhold said 1% from payments made to all Subcontractors with contracts greater than \$80,000.00 and make it payable to the Montana Department of Revenue. The Contractor and all Subcontractors shall also submit documentation of all contracts greater than \$80,000.00 to the Montana Department of Revenue on the Department's prescribed form.

5.3.7. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

#### 5.4. **CONTINGENT ASSIGNMENT OF SUBCONTRACTS**

5.4.1. Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner provided that:

5.4.1.1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor and Contractor in writing; and,

5.4.1.2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

5.4.2. Upon such assignment, if the Work has been suspended for more than 30 days as a result of the Contractor's default, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Such adjustment shall be at the expense of the Contractor.

5.4.3. The Contractor shall engage each of its subcontractors and suppliers with written contracts that preserve and protect the rights of the Owner and include the acknowledgement and agreement of each subcontractor and supplier that the Owner is a third-party beneficiary of their sub-contractual and supplier agreements. The Contractor's agreements shall require that in the event of default by the Contractor or termination of the Contractor, and upon request of the Owner, the Contractor's subcontractors and suppliers will perform services for the Owner.

5.4.4. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

### **ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

#### 6.1. **OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS**

- 6.1.1. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Paragraph 4.3.
- 6.1.2. When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.
- 6.1.3. The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.
- 6.1.4. Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

## 6.2. **MUTUAL RESPONSIBILITY**

- 6.2.1. The Contractor shall afford the Owner and separate contractors reasonable opportunity' for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.
- 6.2.2. If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect/Engineer apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.
- 6.2.3. The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.
- 6.2.4. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Paragraph 12.2.
- 6.2.5. The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Subparagraph 3.14.

## 6.3. **OWNER'S RIGHT TO CLEAN UP**

- 6.3.1. If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect/Engineer will determine the responsibility of those involved and allocate the cost accordingly.

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

### **7.1. GENERAL**

- 7.1.1. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Minor changes as ordered by the Architect/Engineer has the definition provided in Paragraph 7.4
- 7.1.2. A Change Order shall be based upon agreement among the Owner, Contractor, and Architect/Engineer; a Construction Change Directive requires agreement by the Owner and Architect/Engineer and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect/Engineer alone.
- 7.1.3. Changes in the Work shall be performed under applicable provisions of the Contract Documents and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.
- 7.1.4. No act, omission, or course of dealing, shall alter the requirement that Change Orders or Construction Change Directives shall be in writing and signed by the Owner, and that Change Orders and Construction Change Directives are the exclusive method for effecting any adjustment to the Contract. The Contractor understands and agrees that neither the Contract Sum nor the Contract Time can be changed by implication, oral agreement, verbal directive, or unsigned Change Order.

### **7.2. CHANGE ORDERS**

- 7.2.1. A Change Order is a written instrument prepared by the Architect/Engineer and signed by the Owner, Contractor and Architect/Engineer, stating their agreement upon all of the following:
  - 7.2.1.1. change in the Work;
  - 7.2.1.2. the amount of the adjustment, if any, in the Contract Sum; and,
  - 7.2.1.3. the extent of the adjustment, if any, in the Contract Time.
- 7.2.2. The cost or credit to the Owner resulting from a change in the Work shall be determined as follows:
  - 7.2.2.1. Per the limitations of this Subparagraph, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive; or,
  - 7.2.2.2. By one of the methods in Subparagraph 7.3.4, or as determined by the Architect/Engineer per Subparagraph 7.3.9, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive.
  - 7.2.2.3. The Contractor's proposed increase or decrease in cost shall be limited to costs listed in Subparagraph 7.3.9.1 through 7.3.9.5.
- 7.2.3. The Contractor shall not submit any Change Order, response to requested cost proposals, or requested changes which are incomplete and do not contain full breakdown and supporting documentation in the following three areas:
  - 7.2.3.1. Direct costs (only those listed in Subparagraph 7.3.9.1 through 7.3.9.5 are allowable);
  - 7.2.3.2. Indirect costs (limited as a percentage on each Change Order per Paragraph 7.2.2); and

7.2.3.3. Consequential items (e.g. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution).

7.2.4. Any Change Order, responses to requested proposals, or requested changes submitted by the Contractor which, in the opinion of the Architect/Engineer, are incomplete, may be rejected and returned to the Contractor without comment. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all Change Orders, responses to requested proposals, or requested changes are complete prior to submission.

7.2.5. Overhead, applicable to all areas and sections of the Contract Documents, means "Indirect Costs" as referenced in Subparagraph 7.2.3.2. Indirect costs are inclusive of, but not limited to, the following: home office overhead; off-site supervision; home office project management; change order and/or proposal preparation, design, research, negotiation and associated travel; effects of disruption and dilution of management and supervision off-site; time delays; coordination of trades; postage and shipping; and, effective increase in guarantee and warranty durations. Indirect costs applicable to any and all changes in the work, either through Change Order or Construction Change Directive, are limited to the percentage allowance for overhead in Subparagraph 7.2.2.

7.2.6. By signature on any Change Order, the Contractor certifies that the signed Change Order is complete and includes all direct costs, indirect costs and consequential items (including additional time, if any) and is free and clear of all claims or disputes (including, but not limited to, claims for additional costs, additional time, disruptions, and/or impacts) in favor of the Contractor, subcontractors, material suppliers, or other persons or entities concerning the signed change order and on all previously contracted Work and does release the Owner from such claims or demands.

7.2.7. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Change Order shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes which affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time, shall not result in an increase in the Contract Time.

7.2.8. Supervision means on-site, field supervision and not home office overhead, off-site management or off-site supervision.

7.2.9. Labor means those persons engaged in construction occupations as defined in Montana Prevailing Wage Rates for Building Construction or Heavy/Highway as bound in the Contract Documents and does not include design, engineering, superintendence, management, on-site field supervision, home office or other off-site management, off-site supervision, office or clerical work.

### 7.3. **CONSTRUCTION CHANGE DIRECTIVES**

7.3.1. A Construction Change Directive is a written order prepared by the Architect/Engineer directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

7.3.2. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Construction Change Directive, shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes that affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time shall not result in an increase in the Contract Time.

7.3.3. A Construction Change Directive shall be used in the absence of agreement on the terms of a Change Order.

7.3.4. If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- 7.3.4.1. mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
  - 7.3.4.2. unit prices stated in the Contract Documents or subsequently agreed upon;
  - 7.3.4.3. cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee;
  - 7.3.4.4. By actual cost as shown by the Contractor's and Subcontractor's itemized invoices; or
  - 7.3.4.5. as provided in Subparagraph 7.3.9.
- 7.3.5. Costs shall be limited to the following: cost of materials, including cost of delivery; cost of labor, including social security, old age and unemployment insurance and fringe benefits under collective bargaining agreements; workers' compensation insurance; bond premiums; and rental value of power tools and equipment.
- 7.3.6. Overhead and profit allowances shall be limited on all Construction Change Directives to those identified in 7.2.2.
- 7.3.7. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect/Engineer of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.
- 7.3.8. A Construction Change Directive signed by the 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.
- 7.3.9. If the Contractor does not respond or disagrees with the method for adjustment in the Contract Sum in writing within seven (7) calendar days, the method and the adjustment made shall be determined by the Architect/Engineer on the basis of reasonable expenditures and/or savings of those performing the Work directly attributable to the change including, in the case of an increase in the Contract Sum, plus an allowance for overhead and profit as listed under Subparagraph 7.2.2. In such case, and also under Clause 7.3.4.3, the Contractor shall keep and present, in such form as the Architect/Engineer may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.9 shall be limited to the following:
- 7.3.9.1. costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance as determined by the Prevailing Wage Schedules referenced in the Contract Documents;
  - 7.3.9.2. costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
  - 7.3.9.3. rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
  - 7.3.9.4. costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
  - 7.3.9.5. additional costs of field supervision and field office personnel directly attributable to the change.
- 7.3.10. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect/Engineer plus markups in subparagraph 7.2.2. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net change, if any, with respect to that change.



- 7.3.11. Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by a Change Order indicating the parties' agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Architect/Engineer will make an interim determination for purposes of monthly certification for payment for those costs. That determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a claim in accordance with Article 4.
- 7.3.12. When the Owner and Contractor agree with the determination made by the Architect/Engineer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

#### 7.4. **MINOR CHANGES IN THE WORK**

- 7.4.1. The Architect/Engineer will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

### **ARTICLE 8 – TIME**

#### 8.1. **DEFINITIONS**

- 8.1.1. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day shall be determined as the day following the current day of any event or notice starting a specified duration.
- 8.1.2. Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.
- 8.1.3. The date of commencement of the Work is the date established in the NOTICE TO PROCEED AS ISSUED BY THE OWNER.
- 8.1.4. The date the Contractor reaches Substantial Completion is the date certified by the Architect/Engineer in accordance with Paragraph 9.8.
- 8.1.5. The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.
- 8.1.6. Liquidated Damages. The Owner may suffer loss if the project is not substantially complete on the date set forth in the contract documents. The Contractor and his surety shall be liable for and shall pay to the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the work is substantially complete: **As indicated in the instructions to bidders.**
- 8.1.7. The Contractor shall not be charged liquidated or actual damages when delay in completion of the Work is due to:
- 8.1.7.1. Any preference, priority or allocation order issued by the government;
- 8.1.7.2. Unforeseeable cause beyond the control and without the fault or negligence of the Contractor, such as acts of God or of the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. All such occurrences resulting in delay must be documented and approved by Change Order; or,
- 8.1.7.3. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in 8.1.7.1 and 8.1.7.2 of this article.

- 8.1.8. The Contractor is completely obligated and responsible to provide written notice of each day of delay as provided for in Paragraph 4.3.
- 8.1.9. Contract Time. All work shall reach Substantial Completion by: Dates provided in Instructions to bidders and Invitation to bid documents. The Owner will issue a written NOTICE TO PROCEED and finalized contract.

## 8.2. **PROGRESS AND COMPLETION**

- 8.2.1. Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Contract, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.
- 8.2.2. 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 date on the Notice to Proceed and in no case prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance.
- 8.2.3. The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.
- 8.2.4. If the Contractor falls behind the latest construction schedule by more than 14 calendar days through its own actions or inaction, neglect, inexperience, lack of oversight and management of the Work including that of any Subcontractors, written notice to the Owner and Architect/Engineer shall be provided within three (3) days with explanation of how the Contractor intends to get back on schedule. Response to getting back on schedule consists of providing a sufficient number of qualified workers and/or proper materials or an acceptably reorganized schedule to regain the lost time in a manner acceptable to the Owner.

## 8.3. **DELAYS AND EXTENSIONS OF TIME**

- 8.3.1. If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect/Engineer, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending mediation and arbitration, or by other causes which the Architect/Engineer determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect/Engineer may determine.
- 8.3.2. Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.
- 8.3.3. This Paragraph 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

## **PAYMENTS AND COMPLETION**

### 9.1. **CONTRACT SUM**

- 9.1.1. The Contract Sum is stated in the Contract and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

### 9.2. **SCHEDULE OF VALUES**

- 9.2.1. Before the first Application for Payment, the Contractor shall submit to the Architect/Engineer 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 Architect/Engineer may require. This schedule, unless objected to by the Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

### 9.3. **APPLICATIONS FOR PAYMENT**

- 9.3.1. The Contractor shall submit to the Architect/Engineer an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be signed and supported by such data substantiating the Contractor's right to payment as the Owner or Architect/Engineer may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.
- 9.3.2. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.
- 9.3.3. As provided in Subparagraph 7.3.11, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives, or by interim determinations of the Architect/Engineer, but not yet included in Change Orders.
- 9.3.4. Applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.
- 9.3.5. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.
- 9.3.6. The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.
- 9.3.7. Until the work is complete, the Owner will pay 95% of the amount due the Contractor on account of progress payments.
- 9.3.7.1. If the Work and its progress are not in accordance with all or any part, piece, or portion of the Contract Documents, the Owner may, at its sole discretion and without claim by the Contractor, increase the amount held as retainage to whatever level deemed necessary to effectuate performance and progress of the Work, for anticipated repairs, warranties or completion of the Work by the Contractor or through the letting of other contracts. The Contractor will not be entitled to additional costs, expenses, fees, time, and such like, in the event the Owner increases the amount held as retainage due to non-compliance and/or non-performance with all or any part, piece, or portion of the Contract Documents.
- 9.3.7.2. Prior to the first application for payment, the Contractor shall submit the following information on the appropriate forms:
- 9.3.7.2.1. Schedule of Amounts for Contract Payment (Form 100): This form shall contain a breakdown of the labor, material and other costs associated with the various portions of the work and shall be the basis for the progress payments to the Contractor. The use of electronic method shall be in the Owner's format.
- 9.3.7.2.2. Project/Progress Schedule: If no Schedule (or revised Schedule) is provided with each and every Periodic Estimates for Partial Payment, the Architect/Engineer and/or Owner may return the pay request, or hold it, and may choose not pay for any portion of the Work until the appropriate Schedule, indicating all changes, revisions and updates, is provided. No claim for additional costs or interests will

be made by the Contractor or any subcontractor on account of holding or non-payment of the Periodic Estimate for Partial Payment request.

#### 9.3.7.3. Progress Payments

9.3.7.3.1. Periodic Estimates for Partial Payment shall be on a form provided by the Owner (Form 101) and submitted to the Architect/Engineer for payment by the Owner. Payment shall be requested for the labor and material incorporated in the work to date and for materials suitably stored, less the aggregate of previous payments, the retainage, and the 1% gross receipts tax.

9.3.7.3.2. The Contractor, by submission of any partial pay request, certifies that every request for partial payment is correct, true and just in all respects and that payment or credit had not previously been received. The Contractor further warrants and certifies, by submission of any partial pay request, that all previous work for which payment has been received is free and clear of all liens, disputes, claims, security interests, encumbrances, or causes of action of any type or kind in favor of the Contractor, subcontractors, material suppliers or other persons or entities and does release the Owner from such.

9.3.7.3.3. Progress payments do not constitute official acceptance of any portion of the work or materials whether stored on or off-site.

9.3.7.3.4. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due. Each subcontractor who performs work greater than \$80,000 shall have 1% of its gross receipts withheld by the Contractor. The Contractor shall notify the Department of Revenue on the department's prescribed forms.

9.3.7.4. The Contractor may submit obligations/securities in a form specified in 18-1-301 Montana Code Annotated (MCA) to be held by a Financial Institution in lieu of retainage by the Owner. The Owner will establish the amount that would otherwise be held as retainage. Should the Contractor choose to submit obligations/securities in lieu of retainage, the Owner will require the Financial Institution to execute the Owner's "Account Agreement for Deposit of Obligations Other Than Retainage" (Form 120) prior to submission of any obligations/securities in accordance with 18-1-302 MCA. The Contractor must extend the opportunity to participate in all obligations/securities in lieu of retainage on a pro rata basis to all subcontractors involved in the project and shall be solely responsible for the management and administration of same. The Owner assumes no liability or responsibility from or to the Contractor or Subcontractors regarding the latter's participation.

**9.3.7.5.** The Contractor shall maintain a monthly billing cycle.

#### 9.4. **CERTIFICATES FOR PAYMENT**

9.4.1. The Architect/Engineer will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect/Engineer determines is properly due, or notify the Contractor and Owner in writing of the Architect/Engineer's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1. For the purposes of this paragraph regarding certification of payment, electronic mail and/or notes provided through the use of an electronic approval system shall constitute written notice.

9.4.2. The issuance of a Certificate for Payment will constitute a representation by the Architect/Engineer to the Owner, based on the Architect/Engineer's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect/Engineer's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect/Engineer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect/Engineer has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work;

(2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

#### 9.5. **DECISIONS TO WITHHOLD CERTIFICATION**

9.5.1. The Architect/Engineer may withhold or reject a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect/Engineer's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect/Engineer is unable to certify payment in the amount of the Application, the Architect/Engineer will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect/Engineer cannot agree on a revised amount, the Architect/Engineer will promptly issue a Certificate for Payment for the amount for which the Architect/Engineer is able to make such representations to the Owner. The Architect/Engineer may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect/Engineer's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Subparagraph 3.3.4, because of:

9.5.1.1. defective Work not remedied;

9.5.1.2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

9.5.1.3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

9.5.1.4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

9.5.1.5. damage to the Owner or another contractor;

9.5.1.6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or,

9.5.1.7. persistent failure to carry out the Work in accordance with the Contract Documents.

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

9.5.3. Owner's Right to Refuse Payment: The Architect/Engineer's approval, or partial approval, of the Contractor's request for payment shall not preclude or prevent the Owner from exercising any of its remedies under this Contract. The Owner shall have right to refuse to make payment(s) to the Contractor due to:

9.5.3.1. the Contractor's failure to perform the Work in compliance with the Contract Documents;

9.5.3.2. the Contractor's failure to correct any defective or damaged Work;

9.5.3.3. the Contractor's failure to accurately represent the Work performed in the pay request;

9.5.3.4. the Contractor's performance of its Work at a rate or in a manner that, in the Owner's opinion, is likely to result in the Work, or any portion thereof, to be delayed;

9.5.3.5. the Contractor's failure to use funds previously paid to it by the Owner to pay for the Contractor's Work-related obligations including, but not limited to, subcontractors and suppliers on this Project;

9.5.3.6. claims made, or anticipated by the Owner to be made, against the Owner or its property;

- 9.5.3.7. inclusion in the pay request of any amounts in dispute or part of a claim;
- 9.5.3.8. Damage or loss caused by the Contractor, including its subcontractors and suppliers; or,
- 9.5.3.9. The Contractor's failure or refusal to perform its obligations to the Owner.

#### 9.6. **PROGRESS PAYMENTS**

- 9.6.1. After the Architect/Engineer has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents or the Owner may take any action the Owner deems necessary under Subparagraph 9.5.3.
- 9.6.2. The Contractor shall promptly pay each Subcontractor in accordance with Title 28, Chapter 2, Part 21, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.
- 9.6.3. The Contractor is prohibited from holding higher amounts in retainage on any Subcontractor than the Owner is holding from the Contractor.
- 9.6.4. The Architect/Engineer will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect/Engineer and Owner on account of portions of the Work done by such Subcontractor.
- 9.6.5. Neither the Owner nor Architect/Engineer shall have an obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.
- 9.6.6. Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3, 9.6.4, and 9.6.5.
- 9.6.7. A Certificate for Payment, 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.
- 9.6.8. Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

#### 9.7. **FAILURE OF PAYMENT**

- 9.7.1. If the Owner does not approve payment to the Contractor within thirty-five (35) calendar days after the receipt of a certified Application for Payment, then the Contractor may, upon seven additional days' written notice to the Owner and Architect/Engineer, suspend the Work until payment of the amount owing has been received. Nothing in the Subparagraph shall limit the Owner's rights and options as provided in Subparagraph 9.5.3. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

#### 9.8. **SUBSTANTIAL COMPLETION**

- 9.8.1. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

- 9.8.2. When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect/Engineer a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.
- 9.8.3. Upon receipt of the Contractor's list, the Architect/Engineer will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect/Engineer's Inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect/Engineer. In such case, the Contractor shall then submit a request for another inspection by the Architect/Engineer to determine Substantial Completion.
- 9.8.4. The Contractor shall ensure the project is substantially complete prior to requesting any inspection by the Architect/Engineer so that no more than one (1) inspection is necessary to determine Substantial Completion for all or any portion of the Work. If the Contractor does not perform adequate inspections to develop a comprehensive list as required in Subparagraph 9.8.2 and does not complete or correct such items upon discovery or notification, the Contractor shall be responsible and pay for the costs of the Architect/Engineer's additional inspections to determine Substantial Completion.
- 9.8.5. When the Work or designated portion thereof is substantially complete, the Architect/Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion and which shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. After issuance of the Certificate of Substantial Completion, the Contractor shall finish and complete all remaining items within thirty (30) calendar days of the date on the Certificate. The Architect/Engineer shall identify and fix the time for completion of specific items which may be excluded from the thirty (30) calendar day time limit. Failure to complete any items within the specified time frames may be deemed by the Owner as default of the contract on the part of the Contractor.
- 9.8.6. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety if there are claims or past payment issues, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

## 9.9. **PARTIAL OCCUPANCY OR USE**

- 9.9.1. 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, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Work. 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, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect/Engineer as provided under Subparagraph 9.8.2. 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 written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect/Engineer.
- 9.9.2. Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect/Engineer 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.

- 9.9.3. 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.

9.10. **FINAL COMPLETION AND FINAL PAYMENT**

- 9.10.1. 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 Architect/Engineer will promptly make such inspection and, when the Architect/Engineer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect/Engineer will approve the Contractor's final Certificate for Payment stating that to the best of the Architect/Engineer's knowledge, information and belief, and on the basis of the Architect/Engineer's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect/Engineer's signature on the Contractor's final Certificate for Payment will constitute a further representation that conditions listed in Subparagraph 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.
- 9.10.2. Neither final payment nor any remaining retainage shall become due until the Contractor submits to the Architect/Engineer:
- 9.10.2.1. completed Contractor's Affidavit of Completion, Payment of Debts and Claims, and Release of Liens (Form 106) that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied;
- 9.10.2.2. a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner;
- 9.10.2.3. a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents
- 9.10.2.4. Consent of Surety Company to Final Payment (Form 103); and,
- 9.10.2.5. if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.
- 9.10.3. The Contractor and his surety accepts and assumes responsibility, liability, and costs for and agrees to defend and hold harmless the Owner for and against any and all actions as a result of the Owner making final payment.
- 9.10.4. By submitting any Application for Payment to the Architect/Engineer the Contractor and his surety certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the Contractor and all Subcontractors and used in the execution of the Contract will be fully paid upon receipt of Final Payment and that there are no unpaid obligations, liens, claims, security interests, encumbrances, liabilities and/or demands of State Agencies, subcontractors, suppliers, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the Contractor under the contract.
- 9.10.5. In consideration of the prior payments and the final payment made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the parties, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to the contract and authorized changes.
- 9.10.6. The date of Final Payment by the Owner shall constitute Final Acceptance of the Work. The determining date for the expiration of the warranty period shall be as specified in Paragraphs 3.5 and 12.2.2.



- 9.10.7. If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect/Engineer so confirms, the Owner shall, upon application by the Contractor and certification by the Architect/Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect/Engineer prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
- 9.10.8. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:
- 9.10.8.1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- 9.10.8.2. failure of the Work to comply with the requirements of the Contract Documents; or,
- 9.10.8.3. terms of special warranties required by the Contract Documents.
- 9.10.9. Acceptance of final payment by the Contractor, a Subcontractor, or material supplier, shall constitute a waiver of any and all obligations, liens, claims, security interests, encumbrances and/or liabilities against the Owner except those previously made in writing per the requirements of Paragraph 4.3 and as yet unsettled at the time of submission of the final Application for Payment.
- 9.10.10. The Owner's issuance of Final Payment does not constitute a waiver or release of any kind regarding any past, current, or future claim the Owner may have against the Contractor and/or the surety.

## **ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY**

### **10.1. SAFETY**

- 10.1.1. **Importance of Safety.** The Contractor and all Subcontractors (at any tier or level) recognize that safety is paramount at all times. The Contractor shall perform the work in a safe manner with the highest regard for safety of its employees and all other individuals and property at the work site. Contractor shall maintain its tools, equipment, and vehicles in a safe operating condition and take all other actions necessary to provide a safe working environment for performance of work required under this Contract. The Contractor is solely responsible for the means, methods, techniques, sequences and procedures for coordinating and constructing the Work, including all site safety, safety precautions, safety programs, and safety compliance with OSHA and all other governing bodies.
- 10.1.2. **Particular Safeguards.** (a). The Contractor shall erect and maintain, as required by Paragraphs 10.1.1 and 10.1.3, safeguards for safety and protection, including posting danger signs and other warnings against hazards, installing suitable barriers and lighting, promulgating safety regulations, and providing notification to all parties who may be impacted by the Contractor's operations. (b) When use or storage of explosives or other Hazardous Materials/Substances (defined below) or equipment are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. (c) The Contractor shall not encumber or load or permit any part of the construction site to be encumbered or loaded so as to endanger the safety of any person(s).
- 10.1.3. **Compliance with Safety Laws.** Contractor represents and warrants to Owner that it knows and understands all federal, state and local safety statutes, rules, and regulations (Laws) related to the work under this Contract. Contractor shall comply with these Laws. Contractor shall keep all material data safety sheets on site and available at all times.
- 10.1.4. **Remedy property damage.** The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor of any tier or level, or anyone employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.

- 10.1.5. **Designation of Safety Representative.** Unless the Contractor designates, in writing to the Owner and the Architect/Engineer, another responsible member of the Contractor's organization as the Safety Representative, the Contractor's superintendent is the Safety Representative. The Safety Representative is defined as that member of the Contractor's organization responsible for all safety under this Contract.
- 10.1.6. **Release/Indemnity of Owner and Architect/Engineer.** The Contractor agrees that the Owner and Architect/Engineer are not responsible for safety at the work site and releases them from all obligations and liability regarding safety at the work site. The Contractor shall indemnify and defend the Owner and the Architect/Engineer against and from all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses (including but not limited to court costs and reasonable attorney fees), arising from injuries and death to any persons and damage to real and personal property arising from, in connection with, or incidental to Contractor's safety responsibilities under this Contract.

## 10.2. **HAZARDOUS MATERIALS/SUBSTANCES**

- 10.2.1. "Hazardous Materials/Substances" means any substance: (a) the presence of which requires investigation, or remediation under any federal, state or local statute, rule, regulation, ordinance, order, policy or common law; (b) that is or becomes defined as "hazardous waste," "hazardous substance," pollutant, or contaminant under any federal, state or local statute, rule, regulation, or ordinance or amendments thereto; (c) that is toxic, explosive, corrosive flammable, or otherwise hazardous and is or becomes regulated by any government authority, agency, board, commission or instrumentality of the United States, the state of Montana or any political subdivision thereof; (d) gasoline, diesel fuel or other petroleum hydrocarbons; (e) containing contains polychlorinated biphenyls (PCBs) or asbestos; or (f) the presence of which causes or threatens to cause a nuisance or trespass on the work site or adjacent property.
- 10.2.2. The Contractor is solely responsible for all compliance with all regulations, requirements, and procedures governing Hazardous Materials/Substances at the Work Site or that Contractor brings on the site. The Contractor is solely responsible for remediation, costs, damages, loss, and/or expenses for all Hazardous Materials/Substances brought to the site. The Contractor shall not and is strictly prohibited from purchasing and/or installing any asbestos-containing materials or products as part of the Work. Should the Contractor do so, the Contractor shall be solely responsible for the immediate remediation and all costs, damages, loss, and/or expenses per Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.
- 10.2.3. If the Contractor encounters Hazardous Materials/Substances during the course of the Work, whether or not identified in the Contract Documents, Work, the Contractor agrees that:
- 10.2.3.1. Encountering any Hazardous Materials/Substances during performance of the Work does not necessarily mean a change in conditions has occurred, nor is it evidence that the Contractor is due additional Contract Time or an increase in the Contract Sum. If encountering Hazardous Materials/Substances is determined to be a change in conditions to the Contract Documents, Paragraph 4.3 and Article 7 apply in determining any additional compensation or extension of time claimed by the Contractor.
- 10.2.3.2. The Contractor is solely responsible for securing the Work in accordance with this Article 10 involving any Hazardous Materials/Substances against unlawful, unregulated, or improper intrusion, disturbance, or removal. The Contractor shall implement protections and take protective actions throughout the performance of the Work to prevent exposure to workers, occupants, and contamination of the site or area.
- 10.2.3.3. If the Contractor is unable to or fails to properly secure the Work against unlawful, unregulated, or improper intrusion, disturbance, or removal of Hazardous Materials/Substances, the Contractor shall immediately implement protections and take protective actions, up to and including stopping Work in the area or on the item affected, to prevent exposure to workers, occupants, and contamination of the site or area. The Contractor shall immediately notify the Owner and Architect in writing giving details of the failure and the corrective actions taken. If the condition is an emergency and notice cannot be provided in writing, then Contractor shall orally and immediately notify the Owner and Architect/Engineer of the condition followed by a full written explanation. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss.

10.2.3.4. If the Contractor notifies the Owner and takes precautions in accordance with this Article 10 upon encountering materials/substances suspected of containing asbestos or polychlorinated biphenyls that are unidentified in the Contract Documents, the Owner shall verify if the unidentified material or substance contains asbestos or polychlorinated biphenyls and shall arrange for the removal or other measures as necessary to allow the Contractor to proceed with the Work. The Contract Time may be extended as appropriate if the Work affected is on the critical path and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs as provided in Article 7. Should the Contractor fail to notify the Owner upon encountering asbestos, polychlorinated biphenyls, or materials/substances suspected of containing asbestos or polychlorinated biphenyls, that are unidentified in the Contract Documents, the Contractor is solely responsible for all mitigation in accordance with Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.

10.2.4. The Contractor shall indemnify, hold harmless, and defend the Owner from and against all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses, including but not limited to court costs and reasonable attorneys' fees, arising from, in connection with, or incidental to the Contractor's handling, disposal, encountering, or release of Hazardous Materials/Substances.

### 10.3. **UTILITIES**

10.3.1. Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water, telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially sensitive and the slightest damage to these components will result in disruption of the operations of the campus.

10.3.2. "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter, pink paint and flags will be accepted.

10.3.3. After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while digging. Such responsibility shall include all necessary care including hand digging. Contractor's responsibility shall also include maintaining markings after initial locate. The area for such responsibility, unless otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility line.

10.3.4. The Contractor's responsibility shall include repair or replacement of damaged utilities. The Contractor will also be responsible for all costs associated with reterminations and recertification.

10.3.5. Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall immediately contact the Owner and the Architect/Engineer. If, after exposing an unlocated buried utility, the Contractor continues digging without notifying Owner and Architect/Engineer and further damages the utility, the Contractor will be fully and solely responsible.

10.3.6. Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately repaired and tested will require the Contractor to return when the system is in service to complete the repair.

10.3.7. In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Owner at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days' notice to the Owner. The Contractor shall bear all costs associated with the interruptions and restorations of service.

## **ARTICLE 11 - INSURANCE AND BONDS**

### 11.1. **CONTRACTOR'S LIABILITY INSURANCE**

- 11.1.1. The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the State of Montana with a rating no less than "A-", such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:
  - 11.1.1.1. claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;
  - 11.1.1.2. claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
  - 11.1.1.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
  - 11.1.1.4. claims for damages insured by usual personal injury liability coverage;
  - 11.1.1.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;
  - 11.1.1.6. claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
  - 11.1.1.7. claims for bodily injury or property damage arising out of completed operations; and,
  - 11.1.1.8. claims involving contractual liability insurance applicable to the Contractor's obligations under Paragraph 3.18.
- 11.1.2. The insurance required by Subparagraph 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until termination of any coverage required to be maintained after final payment.
- 11.1.3. Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies except Workers Compensation required by this Paragraph 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner. The Workers Compensation policy will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner by the Contractor. If any of the foregoing insurance coverages are required to remain in force after final payment, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Subparagraph 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.
- 11.1.4. At the request of the Owner, the Contractor shall provide copies of all insurance policies to the Owner.

## 11.2. **INSURANCE, GENERAL REQUIREMENTS**

- 11.2.1. The Contractor shall maintain for the duration of the contract, at its cost and expense, insurance against claims for injuries to persons or damages to property, including contractual liability, which may arise from or in connection with the performance of the Work by the Contractor, its agents, employees, representatives, assigns, or subcontractors. The Contractor is responsible for all deductibles regardless of policy or level of coverage. The Owner reserves the right to demand, and the Contractor agrees to provide, copies of any and all policies at any time.

- 11.2.2. Hold Harmless and Indemnification: The Contractor shall protect, defend, and save the state, its elected and appointed officials, agents, and employees, while acting within the scope of their duties as such, harmless from and against all claims, liabilities, demands, causes of action, and judgments whatsoever (including the cost of defense and reasonable attorney fees): 1) arising in favor of or asserted by third parties on account of damage to property, personal injury, or death which injury, death, or damage; or, 2) arising out of or resulting from performance or failure to perform, or omissions of services, or in any way results from the negligent acts or omissions of the Contractor, its agents, agents, or subcontractors.
- 11.2.3. Contractor's Insurance: insurance required under all sections herein shall be in effect for the duration of the contract that extends through the warranty period. Insurance required herein shall be provided by insurance policies issued only by insurance companies currently authorized to do business in the state of Montana. No Contractor or Sub-contractor shall commence any Work under this contract until all required insurance has been obtained. During the term of this contract, the Contractor shall, not less than thirty days prior to the expiration date of any policy for which a certificate of insurance is required, deliver to the Owner a certificate of insurance with respect to the renewal insurance policy. The Contractor shall furnish one copy of insurance certificates of insurance herein required, which shall specifically set forth evidence of all coverage required by these contract documents and which shall be signed by authorized representatives of the insurance company or companies evidencing that insurance as required herein is in force with the exception of Workers Compensation and will not be canceled, limited or restricted without thirty days' written notice by certified mail to the contractor and the Owner. The Workers Compensation policy will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner by the Contractor. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. Additionally, all certificates shall include the project name and A/E project number.
- 11.2.4. Certificates of Insurance and Endorsements. All certificates of insurance and the additional insured endorsements are to be received by the state prior to issuance of the Notice to Proceed. The contractor is responsible to ensure that all policies and coverages contain the necessary endorsements for the State being listed as an additional insured. The state reserves the right to require complete copies of all insurance policies at any time to verify coverage. The contractor shall notify the state within 30 days of any material change in coverage.

### 11.3. **WORKERS' COMPENSATION INSURANCE**

- 11.3.1. The Contractor shall carry **Workers' Compensation Insurance**. Such Workers' Compensation Insurance shall protect the Contractor from claims made by his own employees, the employees of any Sub-contractor, and also claims made by anyone directly or indirectly employed by the Contractor or Sub-contractor. The Contractor shall require each Sub-contractor similarly to provide Workers' Compensation Insurance.

### 11.4. **COMMERCIAL GENERAL LIABILITY INSURANCE**

- 11.4.1. Each Contractor shall carry per occurrence coverage **Commercial General Liability Insurance** including coverage for premises; operations; independent contractor's protective; products and completed operations; products and materials stored off-site; broad form property damage and comprehensive automobile liability insurance with not less than the following limits of liability:

11.4.1.1. **\$1,000,000 per occurrence; aggregate limit of \$2,000,000;**

- 11.4.2. The **Commercial General and Automobile Liability Insurance** shall provide coverage for both bodily injury, including accidental death, sickness, disease, occupational sickness or disease, personal injury liability coverage and property damage which may arise out of the work under this contract, or operations incidental thereto, whether such work and operations be by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by the Contractor or by Sub-contractor, or by anyone for whose acts any of them may be liable. The Contractor shall maintain the liability insurance required herein for a period of not less than one year after final payment or anytime the Contractor goes on to the location of the project.

- 11.4.3. The Contractor's liability insurance policies shall list the STATE OF MONTANA as an additional insured. **AN ADDITIONAL INSURED ENDORSEMENT DOCUMENT SHALL BE SUBMITTED WITH THE CERTIFICATES OF INSURANCE.** The STATE OF MONTANA includes its officers, elected and appointed officials, employees and volunteers and political subdivisions thereof. Should the Contractor not be able to list the state as an additional insured, the Contractor shall purchase a per occurrence Owner's/Contractor's Protective Policy (OCP) with the STATE OF MONTANA as the insured party in the same occurrence and aggregate limits as that indicated above for the Contractor's Commercial General Liability Policy.
- 11.4.4. Property damage liability insurance shall be written without any exclusion for injury to or destruction of any building, structure, wires, conduits, pipes, or other property above or below the surface of the ground arising out of the blasting, explosion, pile driving, excavation, filling, grading or from the moving, shoring, underpinning, raising, or demolition of any building or structure or structural support thereof.
- 11.4.5. The Contractor's insurance coverage shall be PRIMARY insurance as respects the State, its officers, elected and appointed officials, employees and volunteers. Any insurance or self-insurance maintained by the state, its officers, elected and appointed officials, employees and volunteers shall be excess of the Contractor's insurance and shall not contribute to it. NO WAIVERS OF SUBROGATION OR ENDORSEMENTS LIMITING, TRANSFERRING, OR OTHERWISE INDEMNIFYING LIABLE OR RESPONSIBLE PARTIES OF THE CONTRACTOR OR ANY SUBCONTRACTOR WILL BE ACCEPTED.

#### 11.5. **PROPERTY INSURANCE (ALL RISK)**

- 11.5.1. New Construction (for projects involving new construction): At its sole cost and expense, the contractor shall keep the building and all other improvements on the premises insured throughout the term of the agreement against the following hazards:
- 11.5.1.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map, [NEHRP.pdf \(mt.gov\).pdf](#) in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire insurance policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.
- 11.5.1.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.
- 11.5.1.3. Loss or damage by explosion of steam boilers, pressure vessels, and oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.
- 11.5.2. Building Renovation (for projects involving building renovation or remodeling):
- 11.5.2.1. The contractor shall purchase and maintain Builder's Risk/Installation insurance on a "special causes of loss" form (so called "all risk") for the cost of the work and any subsequent modifications and change orders. The contractor is not responsible for insuring the existing structure for Builder's Risk/Installation insurance.
- 11.5.2.2. At its sole cost and expense, the contractor shall insure all property construction on the premises throughout the term of the agreement against the following hazards:
- 11.5.2.2.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map at <http://rmtd.mt.gov/Portal/62/aboutus/publications/files/NEHRP.pdf> in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.
- 11.5.2.2.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.

- 11.5.2.2.3. Loss or damage by explosion of steam boilers, pressure vessels, oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

**11.6. ASBESTOS ABATEMENT INSURANCE**

- 11.6.1. If Asbestos Abatement is identified as part of the Work under this contract, the Contractor or any subcontractor involved in asbestos abatement shall purchase and maintain **Asbestos Liability Insurance** for coverage of bodily injury, sickness, disease, death, damages, claims, errors or omissions regarding the asbestos portion of the work ***in addition to*** the CGL Insurance by reason of any negligence in part or in whole, error or omission committed or alleged to have been committed by the Contractor or anyone for whom the Contractor is legally liable.
- 11.6.2. Such insurance shall be in "per occurrence" form and shall clearly state on the certificate that asbestos work is included in the following limits:
  - 11.6.2.1. **\$1,000,000 per occurrence; aggregate limit of \$2,000,000.**
- 11.6.3. Asbestos Liability Insurance as carried by the asbestos abatement subcontractor in these limits in lieu of the Contractor's coverage is acceptable provided the Contractor and the State of Montana are named as additional insureds and that the abatement subcontractor's insurance is PRIMARY as respects both the Owner and the Contractor. If the Contractor or any other subcontractor encounters asbestos, all operations shall be suspended until abatement with the associated air monitoring clearances are accomplished. The certificate of coverage shall be provided by the asbestos abatement subcontractor to both the Contractor and the Owner.

**11.7. PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON PROJECTS EXCEEDING \$150,000.00 IN VALUE)**

- 11.7.1. The Contract shall furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201 MCA). The Contractor shall also furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201MCA). The bonds shall be executed on forms furnished by the Owner and no other forms or endorsements will be acceptable. The bonds shall be signed in compliance with state statutes (33-17-1111 MCA). Bonds shall be secured from a state licensed bonding company. Power of Attorney is required with each bond. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney:
  - 11.7.1.1. one original copy shall be furnished with each set of bonds.
  - 11.7.1.2. Others furnished with a set of bonds may be copies of that original.
- 11.7.2. The Owner reserves the right at any time during the performance of Work to require bonding of Subcontractors provided by the General Contractor. Should this occur, the Owner will cover the direct cost. This shall not be construed as to in any way affect the relationship between the General Contractor and his Subcontractors.
- 11.7.3. Surety must have an endorsement stating that their guarantee of Contractor's performance automatically covers the additional contract time added to a Contractor's contract by Change Order.
- 11.7.4. A change in the Contractor's organization shall not constitute grounds for Surety to claim a discharge of their liability and requires an endorsement from Surety so stating.
- 11.7.5. Except as noted below, the Contractor is required to notify Surety of any increase in the contract amount resulting from a Change Order within 48 hours of signing and submitting a Change Order and shall submit a copy of Surety's written acknowledgment and consent to Owner before a Change Order can be approved. The Surety's written acknowledgment and consent on the Change Order form shall also satisfy this consent requirement.

- 11.7.5.1. Surety consent shall not be required on Change Order(s) which, in the aggregate total amount of all Changes Orders, increase the original contract amount by less than 10%. However, the Contractor is still required to notify Surety of any increase in contract amount resulting from a Change Order(s) within 48 hours of signing and submitting every Change Order.
- 11.7.5.2. Surety is fully obligated to the Owner for the full contract amount, inclusive of all Change Orders, regardless of whether or not written acknowledgement and consent is received and regardless of whether or not the aggregate total of all Change Orders is more or less than 10% of the original contract amount.
- 11.7.5.3. A fax with hard copy to follow of Surety's written acknowledgment and consent is acceptable. If hard copy is not received by Owner before Application for Payment on any portion or all of said Change Order, it will not be accepted by Owner for payment.
- 11.7.6. The Surety must take action within 30 days of notice of default on the part of the Contractor or of any claim on bonds made by the Owner or any Subcontractor or supplier.

## **ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK**

### **12.1. UNCOVERING OF WORK**

- 12.1.1. If a portion of the Work is covered contrary to the Architect/Engineer's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect/Engineer, be uncovered for the Architect/Engineer's examination 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/Engineer has not specifically requested to examine prior to it being covered, the Architect/Engineer 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 at the Owner's expense. If such Work is not in accordance with the Contract Documents, correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

### **12.2. CORRECTION OF WORK**

#### **12.2.1. BEFORE OR AFTER SUBSTANTIAL COMPLETION**

- 12.2.1.1. The Contractor shall promptly correct Work that fails to conform to the requirements of the Contract Documents or that is rejected by the Architect/Engineer, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect/Engineer's services and expenses made necessary thereby, shall be at the Contractor's expense. The Contractor is responsible to discover and correct all defective work and shall not rely upon the Architect/Engineer's or Owner's observations.
- 12.2.1.2. Rejection and Correction of Work in Progress. During the course of the Work, the Contractor shall inspect and promptly reject any Work that:
  - 12.2.1.2.1. does not conform to the Construction Documents; or,
  - 12.2.1.2.2. does not comply with any applicable law, statute, building code, rule or regulation of any governmental, public and quasi-public authorities, and agencies having jurisdiction over the Project.
- 12.2.1.3. The Contractor shall promptly correct or require the correction of all rejected Work, whether observed before or after Substantial Completion. The Contractor shall bear all costs of correcting such Work, including additional testing, inspections, and compensation for all services and expenses necessitated by such corrective action.



## 12.2.2. AFTER SUBSTANTIAL COMPLETION AND AFTER FINAL ACCEPTANCE

12.2.2.1. In addition to the Contractor's obligations under Paragraph 3.5, if, within one year after the date of Final Acceptance 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 to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect/Engineer, the Owner may correct it in accordance with Paragraph 2.3.

12.2.2.1.1. The Contractor shall remedy any and all deficiencies due to faulty materials or workmanship and pay for any damage to other work resulting there from, which shall appear within the period of Substantial Completion through one (1) year from the date of Final Acceptance in accordance with the terms and conditions of the Contract and with any special guarantees or warranties provided in the Contract Documents. The Owner shall give notice of observed deficiencies with reasonable promptness. All questions, claims or disputes arising under this Article shall be decided by the Architect/Engineer. All manufacturer, product and supplier warranties are in addition to this Contractor warranty.

12.2.2.1.2. The Contractor shall respond within seven (7) days after notice of observed deficiencies has been given and he shall proceed to immediately remedy these deficiencies.

12.2.2.1.3. Should the Contractor fail to respond to the notice or not remedy those deficiencies; the Owner shall have this work corrected at the expense of the Contractor.

12.2.2.1.4. Latent defects shall be in addition to those identified above and shall be the responsibility of the Contractor per the statute of limitations for a written contract (27-2-208 MCA) starting from the date of Final Acceptance.

12.2.2.2. The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work.

12.2.2.3. The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Paragraph 12.2.

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

12.2.5. Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the one-year period for correction of Work as described in Subparagraph 12.2.2 relates only to the specific obligation of the Contractor to correct 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 other than specifically to correct the Work.

## 12.3. ACCEPTANCE OF NONCONFORMING WORK

- 12.3.1. If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## **ARTICLE 13 - MISCELLANEOUS PROVISIONS**

### **13.1. GOVERNING LAW**

- 13.1.1. The Contract shall be governed by the laws of the State of Montana and venue for all legal proceedings shall be the First Judicial District, Lewis & Clark County.

### **13.2. SUCCESSORS AND ASSIGNS**

- 13.2.1. The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempt to make such assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

### **13.3. WRITTEN NOTICE**

- 13.3.1. Written notice shall 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 officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

### **13.4. RIGHTS AND REMEDIES**

- 13.4.1. 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.
- 13.4.2. No action or failure to act by the Owner, Architect/Engineer or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

### **13.5. TESTS AND INSPECTIONS**

- 13.5.1. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality control or assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.
- 13.5.2. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect/Engineer timely notice of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.
- 13.5.3. If the Architect/Engineer, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.2, the Architect/Engineer will, upon written authorization from the Owner, instruct the Contractor to make

arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect/Engineer of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. Such costs, except as provided in Subparagraph 13.5.4 shall be at the Owner's expense.

- 13.5.4. If such procedures for testing, inspection or approval under Subparagraphs 13.5.2 and 13.5.3 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect/Engineer's services and expenses shall be at the Contractor's expense.
- 13.5.5. 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 Architect/Engineer.
- 13.5.6. If the Architect/Engineer is to observe tests, inspections or approvals required by the Contract Documents, the Architect/Engineer will do so promptly and, where practicable, at the normal place of testing.
- 13.5.7. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

#### 13.6. **INTEREST**

- 13.6.1. Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

#### 13.7. **COMMENCEMENT OF STATUTORY LIMITATION PERIOD**

- 13.7.1. As between the Owner and Contractor:

- 13.7.1.1. **Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;
- 13.7.1.2. **Between Substantial Completion and Final Certificate for Payment.** As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and,
- 13.7.1.3. **After Final Payment.** As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

#### 13.8. **PAYROLL AND BASIC RECORDS**

- 13.8.1. Payrolls and basic records pertaining to the project shall be kept on a generally recognized accounting basis and shall be available to the Owner, Legislative Auditor, the Legislative Fiscal Analyst or his authorized representative at mutually convenient times. Accounting records shall be kept by the Contractor for a period of three years after the date of the Owner's Final Acceptance of the Project.

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

#### 14.1. **TERMINATION BY THE CONTRACTOR**

- 14.1.1. The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:
  - 14.1.1.1. issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped; or,
  - 14.1.1.2. an act of government, such as a declaration of national emergency which requires all Work to be stopped.
- 14.1.2. The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Paragraph 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.
- 14.1.3. If one of the reasons described in Subparagraph 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect/Engineer, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit but not damages.
- 14.1.4. If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect/Engineer, terminate the Contract and recover from the Owner as provided in Subparagraph 14.1.3.

#### 14.2. **TERMINATION BY THE OWNER FOR CAUSE**

- 14.2.1. The Owner may terminate the Contract if the Contractor:
  - 14.2.1.1. persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
  - 14.2.1.2. fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
  - 14.2.1.3. persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or,
  - 14.2.1.4. otherwise is guilty of any breach of a provision of the Contract Documents.
- 14.2.2. When any of the above reasons exist, the Owner, upon certification by the Architect/Engineer that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:
  - 14.2.2.1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
  - 14.2.2.2. accept assignment of subcontracts pursuant to Paragraph 5.4; and,
  - 14.2.2.3. finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

- 14.2.3. When the Owner terminates the Contract for one of the reasons stated in Subparagraph 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.
- 14.2.4. If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect/Engineer's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect/Engineer, upon application, and this obligation for payment shall survive termination of the Contract.

**14.3. SUSPENSION BY THE OWNER FOR CONVENIENCE**

- 14.3.1. 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.
- 14.3.2. The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Subparagraph 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:
  - 14.3.2.1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or,
  - 14.3.2.2. that an equitable adjustment is made or denied under another provision of the Contract.

**14.4. TERMINATION BY THE OWNER FOR CONVENIENCE**

- 14.4.1. The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.
- 14.4.2. Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall:
  - 14.4.2.1. cease operations as directed by the Owner in the notice;
  - 14.4.2.2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work, and;
  - 14.4.2.3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.
- 14.4.3. In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination. The Contractor shall provide a full and complete itemized accounting of all costs.

**ARTICLE 15 – EQUAL OPPORTUNITY**

- 15.1. The Contractor and all Sub-contractors shall not discriminate against any employee or applicant for employment because of race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability and shall comply with all Federal and State laws concerning fair labor standards and hiring practices. The Contractor shall ensure that applicants are employed, and that employees are treated during employment, without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.
- 15.2. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and

selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

15.3. The Contractor and all Sub-contractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.

15.4. The contractor shall not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association, and the Contractor shall not discriminate during the term of the contract against a firearm entity or firearm trade association. This section shall be construed in accordance with 30-20-301, MCA.

15.4.1. The provisions of 30-20-301, MCA apply only to a contract that:

15.4.1.1. is between a governmental entity and a company with at least 10 full-time employees; and

15.4.1.2. has a value of at least \$100,000 that is paid wholly or partly from public funds of the governmental entity.

15.4.2. By the signing the contract, the Contractor certifies and affirms:

15.4.2.1. Contractor does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association during the term of this contract; and

15.4.2.2. Contractor will not discriminate against a firearm entity or firearm trade association during the term of this contract.

15.4.3. The contractor's certification is made in compliance with and in reference to 30-20-301, MCA, and the terms defined therein. If the contractor determines the provisions of 30-20-301, MCA don't apply to the contract, the Contractor shall submit a statement set forth in details the basis for such determination.

[END OF GENERAL CONDITIONS]

# SUPPLEMENTAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

(REVISED NOVEMBER 2023)

## FOR STATE OF MONTANA GENERAL CONDITIONS

### ARTICLE 1 – GENERAL PROVISIONS

#### 1.1 BASIC DEFINITIONS

##### 1.1.3 SPECIFICATIONS

**1.1.3.1 ADD:** “Approved”: When used to convey Architect’s/Engineer’s action on Contractor’s submittals, applications, and requests, “approved” is limited to Architect’s/Engineer’s duties and responsibilities as stated in the Conditions of the Contract.

**1.1.3.2 ADD:** “Directed”: A command or instruction by Architect/Engineer. Other terms including “requested,” “authorized,” “selected,” “required,” and “permitted” have the same meaning as “directed.”

**1.1.3.3 ADD:** “Indicated”: Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including “shown,” “noted,” “scheduled,” and “specified” have the same meaning as “indicated.”

**1.1.3.4 ADD:** “Regulations”: Laws ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

**1.1.3.5 ADD:** “Furnish”: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

**1.1.3.6 ADD:** “Install”: Operations at Project site including unloading, temporarily shoring, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

**1.1.3.7 ADD:** “Provide”: Furnish and install, complete and ready for the intended use.

**1.1.3.8 ADD:** “Project site”: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land or portion of the building on which the Project is to be built.

**1.6.1 Insert** in the sixth line: “All documents which constitute the instruments of service are the property of the Owner.” In lieu of the phrase “Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer’s consultants shall be deemed the authors of them... except as defined in the Owner’s Contract with the Architect/Engineer.”

### ARTICLE 2 – THE OWNER

#### 2.1 THE STATE OF MONTANA

**2.1.1.1 ADD:** The State of Montana includes its officers, elected and approved officials, employees and volunteers, and political subdivisions thereof. The State of Montana and Montana State University are synonymous throughout the contract documents.

### ARTICLE 3 – THE CONTRACTOR

#### 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

##### **3.3.6 ADD:** PRODUCT DELIVERY, STORAGE AND HANDLING

**3.3.6.1 ADD:** Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer’s written instructions.

**3.3.6.2 ADD: DELIVERY AND HANDLING:**

**3.3.6.2.1 ADD:** Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

**3.3.6.2.2 ADD:** Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

**3.3.6.2.3 ADD:** Deliver products to Project site in an undamaged condition in manufacturer’s original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

**3.3.6.2.4 ADD:** Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and property protected.

**3.3.6.3 ADD: STORAGE**

**3.3.6.3.1 ADD:** Store products to allow for inspection and measurement of quantity or counting of units

**3.3.6.3.2 ADD:** Store materials in a manner that will not endanger Project structure.

**3.3.6.3.3 ADD:** Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

**3.3.6.3.4 ADD:** Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

**3.3.6.3.5 ADD:** Comply with product manufacturer’s written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

**3.3.6.3.6 ADD:** Protect stored products from damage and liquids from freezing.

**3.10 CONSTRUCTION SCHEDULES**

**3.10.1.1 ADD:** A pre-construction meeting will be held at a time mutually agreed upon by the Owner, Architect/Engineer and Contractor at Campus Planning, Design and Construction, Montana State University, Bozeman, Montana. The contractor shall confirm the Contractor’s Construction Schedule for the Work. Coordination of operating requirements of the affected buildings, and surrounds, schedule of activities and Owner requirements will be discussed, as well as the order in which the Contractor intends to pursue the work. This schedule will be reviewed and must be mutually agreed upon by the Architect, Contractor and Owner.

**3.11 DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE**

**3.11.4 ADD:** The contractor shall maintain at the site two (2) construction reference sets of all specifications, drawings, approved shop drawings, change orders and other modifications, addenda, schedules and instructions, in good order.

**3.11.4.1 ADD:** The record drawings shall be two (2) sets of black (or blue) and white prints of the drawings on which the contractor must record all “red line” changes during the course of construction and will include references to change order numbers, field directives, etc., and their dates. This record set shall be maintained separate and apart from documents used for construction reference. This set will be available for review by the project consultant, architect, engineer and MSU project manager at all times.

**3.11.4.2 ADD:** All as-built conditions shall be kept current and the contractor shall not permanently conceal or cover any work until all required information has been recorded.

**3.11.4.3 ADD:** All survey and exterior underground utilities shall be recorded using the spatial reference, Montana State Plane, NAD 83, CORS 96, Lambert Conformal Conic. The National Geodetic Survey publishes NAD 83



coordinates in the metric system (i.e., meters). The conversion factor that should be used to convert between English and metric systems is the international conversion factor of 1 ft. = 0.3048 m. coordinate system.

**3.11.4.4 ADD:** In marking any as-built conditions, the contractor shall ensure that such drawings indicate by measured dimension to building corners or other permanent monuments the exact locations of all piping, conduit or utilities concealed in concrete slabs, behind walls or ceilings or underground. Record drawings shall be made to scale and shall also include exact locations of valves, pull boxes and similar items as required for maintenance or repair service.

**3.11.4.5 ADD:** The contractor shall prepare and maintain a binder with all project warranty information. This will be provided to the project consultant, architect or engineer at final acceptance.

### **3.12.1 DEFINITIONS:**

**3.12.1.4 ADD:** Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term “product” includes the terms “material,” “equipment,” “system,” and terms of similar intent.

**3.12.1.5 ADD:** Named Products: Items identified by manufacturer’s product name, including make or model number or other designation shown or listed in manufacturer’s published product literature that is current as of date of the Contract Documents.

**3.12.1.6 ADD:** New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

**3.12.1.7 ADD:** Comparable Products: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

**3.12.1.8 ADD:** Basis-of-Design Product Specification: A specification in which a specific manufacturer’s product is named and accompanied by the words “basis-of-design product,” including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specifications.

### **3.13. USE OF SITE**

#### **3.13.3 ADD:** MSU BOZEMAN Vehicle Regulations state:

“All students, faculty, staff, and visitors must register any motor vehicle they park on the University campus, for any reason. A visitor is anyone not defined as student, staff or faculty.”

All Contractor and Contractor employees shall comply with Montana State University parking regulations. MSU parking permits can be purchased at the Huffman Building at Seventh Avenue and Kagy Boulevard. Contractor should call University Police at 994-2121 for permit information. Violators of MSU Bozeman Vehicle Regulations may be ticketed and towed.

Unless otherwise indicated on the drawings, all Contractor and Contractor employee vehicles on campus shall be parked in designated parking lots. If allowed on the drawings, vehicles to a maximum number stated, may be parked in project site areas designated and shall only be Contractor vehicles with company signs clearly visible. No personal vehicles shall be parked at the project site in any case. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter moved to a designated lot or leave campus. Vehicles parked in the project site, other than those allowed on the drawings, may be ticketed and towed.

Access to the project site shall be only by the route designated on the drawings. In cases where a different route must be used for a specific purpose, permission must be obtained from MSU Facilities Services. In no case will vehicles be used on the Centennial Mall paving. Access routes are for delivery of equipment, tools, and not for parking.

Site staging areas for materials and equipment if permitted, will be designated on the drawings if permitted. If not designated, staging is intended to be in the construction area boundaries. Staged materials and equipment must be secured on the ground surface or in trailers. Site staging areas shall be fenced.

**3.13.4 ADD:** The Contractor shall coordinate his operations with the Owner in order that the Owner will have maximum use of existing facilities surrounding the area of the Work, as agreed upon, at all times during normal working hours. Contractor further agrees to coordinate his operations so as to avoid interference with the Owner's normal operations to as great an extent as possible.

**3.13.5 ADD:** By acceptance of MSU Building Keys the Contractor agrees with the following: University keys are the property of Montana State University. Fabricating, duplicating or modifying University keys is prohibited. Doors must remain locked at all times. The use of these keys to allow unauthorized persons to enter the above areas is prohibited. Loss of any key must be reported immediately to the Director, Office of Facilities Services and University Police, if the loss of keys results in re-keying costs, these costs will be charged to the Contractor. **See attached Estimated Re-Keying Costs.**

**3.13.6 ADD:** The Montana Legislature decreed that the "right to breath smoke-free air has priority over the desire to smoke" (MCA 20-40-102). It is the policy of MSU to promote the health, wellness and safety of all employees, students, guests, visitors, and contractors while on campus. Therefore, the campus will be free of tobacco-use effective August 1, 2012. The use of tobacco (including cigarettes, cigars, pipes, smokeless tobacco and all other tobacco products) by students, faculty, staff, guests, visitors, and contractors is prohibited on all properties owned or leased by MSU.

Littering any university property, whether owned or leased, with the remains of tobacco products is prohibited.

All university employees, students, visitors, guests, and contractors are required to comply with this policy, which shall remain in effect at all times. Refusal to comply with this policy may be cause for disciplinary action in accordance with employee and student conduct policies. Refusal to comply with the policy by visitors, guests and contractors may be grounds for removal from campus. ([http://www2montana.edu/policy/smoking\\_facilities/](http://www2montana.edu/policy/smoking_facilities/))

**3.13.7 ADD:** The Contractor may use the University's toilet facilities only as directed by the Owner.

## **ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT**

### **4.6. ARBITRATION**

**4.6.3 Insert** in the second line "the Eighteenth Judicial District, Gallatin County" in lieu of "First Judicial District, Lewis & Clark County."

**4.6.11 ADD:** In responding to a claim brought by a Contractor, the Owner shall have a minimum of forty-five (45) days in which to respond to a revised claim prior to the arbitration hearing.

## **ARTICLE 7 – CHANGES IN WORK**

### **7.2 CHANGE ORDERS**

**7.2.2.1 Insert** the word "maximum" before "5%" and insert the word "maximum" before "10%".

**7.2.2.4 ADD:** Total Change Order markup shall not exceed (cost of the work) x 1.15.

**7.2.3.1 Insert** at the beginning of the first sentence the word "Itemized".

**7.2.3.2 Insert** at the beginning of the first sentence the word "Itemized".

**7.2.3.3 Insert** at the beginning of the first sentence the word "Itemized".

**7.2.3.4 ADD:** The Contractor shall provide a complete description summarizing all work involved.

## **ARTICLE 8 - TIME**

### **8.1. DEFINITIONS**

**8.1.8.1 ADD:** The Owner will issue a written Notice to Proceed on satisfactory receipt of the signed Contract and all required bonds, insurance and other required submittals. Work commenced before receipt of the Notice to Proceed will be entirely at the Contractor's risk.

## **8.2. PROGRESS AND COMPLETION**

**8.2.5 ADD:** Completion of the work within the stated time and/or by the date stated on the Notice to Proceed is of the essence of this Contract and failure to complete, without approved time extension, may be considered default of the Contract. At the time for completion as stated on the Notice to Proceed or as extended by approved change order, if the work is not substantially complete, the Owner may notify the Contractor and the Contractor's surety company in writing of the recourse the Owner intends to take, within the Contract, to assess liquidated damages and /or cause the work to be completed.

## **8.3. DELAYS AND EXTENSIONS OF TIME**

**8.3.4 ADD:** By the act of signing the Contract, the Contractor signifies that he/she and all subcontractors can perform the work within the stated schedule and that subcontractors, manufacturers, suppliers, and deliverers are known to be able to support the schedule. Time extension may be granted for unforeseen conditions or events out of the Contractor's control causing delay in delivery of materials or causing delay in the Contractor's ability to perform the work within the Contract Documents. The Contractor is expected to take all possible measures and bear all reasonable costs in order to anticipate, control, counteract, and expedite such delay-causing conditions, including finding alternative sources of materials, equipment, shipping, and labor. Notification of any claim for schedule delay must be made in writing to the Owner within one week of the causing event or of first knowledge of a known delay causing condition with supporting documentation as required by the Owner. The Owner will respond in writing within one week to claims of delay. No claims of delay will be entertained after the date of completion as stated on the Notice to Proceed or as extended by previously approved delay claims.

## **ARTICLE 9 – PAYMENTS AND COMPLETION**

### **9.3. APPLICATIONS FOR PAYMENT**

**9.3.7.2.1. Insert** in the first line "Schedule of Values" in lieu of "Schedule of Amounts for Contract Payment".

**9.3.7.2.3 ADD:** Subcontractor's List: The Contractor shall list all subcontractors doing work in excess of \$5,000.

### **9.8. SUBSTANTIAL COMPLETION**

**9.8.4.1 ADD:** Prior to the inspection, the Contractor shall complete the final clean-up of the project site which, unless otherwise stated in the Contract Documents, shall consist of:

**9.8.4.1.1** Removal of all debris and waste. All construction debris and waste shall be removed from the campus grounds. Use of the University trash containers will not be permitted.

**9.8.4.1.2** Removal of all stains, smears, marks of any kind from surfaces including existing surfaces if said damage is the result of the work.

**9.8.4.1.3** Removal of all temporary structures and barricades.

### **9.10. FINAL COMPLETION AND FINAL PAYMENT**

**9.10.2.4 Insert** in the first line after the word "(Form 103)": "for contracts greater than or equal to \$150,000"

## **ARTICLE 10 – PROTECTIONS OF PERSONS AND PROPERTY**

### **10.1. SAFETY**

**10.1.2 Insert** in the second line before the word "safeguards": "and as approved by Owner,"

**10.1.2.1 ADD:** The Contractor recognizes that the Work will be conducted in and around buildings and areas that are occupied and will continue to function for the purposes of the University. The Contractor shall conduct a project safety meeting prior to the start of the Work, with the Owner's representative and all others that the Owner's representative deems necessary. The purpose of the meeting shall be to produce project specific rules and guidelines pertaining to but not restricted to: safety of persons in and around the area of the Work including type and location of fencing, guards, signage, etc.; closing of existing campus circulation routes and designation of alternate routes,

including creation of temporary routes of access as required; creation and location of temporary signage as required to maintain accessible routes for handicapped access to and around the site of the Work. The Contractor shall be solely responsible for implementing all required means and methods for site safety and security that may be agreed upon in this meeting.

**10.1.2.2 ADD:** Contractor shall notify Owner any time his operations will disrupt use of and access to existing accessible routes. Contractor is solely responsible for maintaining existing accessible routes in the area of the project with the exception of temporary interruptions lasting one day or less. Contractor is responsible for erecting signage identifying temporary re-routing of accessible routes. Such re-routing shall be coordinated with Owner in advance.

### **10.3. UTILITIES**

**10.3.1 ADD:** Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water, telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially sensitive and the slightest damage to these components will result in disruption of the operations of the campus.

**10.3.2 ADD:** "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter, pink paint and flags will be accepted.

**10.3.3 ADD:** After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while digging. Such responsibility shall include all necessary care including hand digging. Contractor's responsibility shall also include maintaining markings after initial locate. The area for such responsibility, unless otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility line. In cases of multiple or overlapping utilities or inconclusive electronic locating signals, MSU Project Manager may specifically indicate a wider area for Contractor's responsibility.

**10.3.4 ADD:** The Contractor's responsibility shall include repair or replacement of damaged utilities. In the event of damage to the 15 KV electrical distribution system, the broadband or fiber optic cables, repair will consist of replacement from termination to termination. Facilities Services and the MSU Information Technology Center will verify repair and recertification. The Contractor will also be responsible for all costs associated with re-terminations and recertification.

**10.3.5 ADD:** Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall immediately contact Facilities Services at the numbers above. If, after exposing an unlocated buried utility, the Contractor continues digging without notifying Facilities Services and further damages the utility, the Contractor will be responsible.

**10.3.6 ADD:** Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately repaired and tested will require the Contractor to return when the system is in service to complete the repair.

**10.3.7 ADD:** In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Facilities Services at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days notice to Facilities Services and the Information Technology Center. The Contractor shall bear all costs associated with the interruptions and restorations of service.

**10.3.8 ADD:** The Owner allows the contractor to use the Owner's utilities (water, heat, electricity) services without charge for procedures necessary for the completion of the work.

## **ARTICLE 11 - INSURANCE AND BONDS**

### **11.4. COMMERCIAL GENERAL LIABILITY INSURANCE**

**11.4.1.3. Insert** in the first line after "State of Montana": ", Montana State University".

### **11.7. PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON THIS PROJECT)**

**11.7.1.** Insert in the first line at the beginning of the sentence "For contracts equal to or greater than \$150,000".

## **11.8. CANCELLATION**

**11.8 ADD** All Certificates shall contain a provision that coverage provided by the policies will not be cancelled without at least thirty (30) days prior notice to the Owner.

## **ARTICLE 13 – MISCELLANEOUS PROVISIONS**

### **13.1. GOVERNING LAW**

**13.1.1. Insert** in the second line “The Eighteenth Judicial District, Gallatin County” in lieu of “First Judicial District, Lewis and Clark County”.

### **13.9 EMERGENCY AND PUBLIC SAFETY**

Montana State University has an Emergency and Public Safety Alert System that warns the campus community in the event of an emergency or public safety event. Because contractors, consultants, and vendors are considered members of the campus community when working on campus, they must be familiar with the alert system and understand when the system is used. Montana State University requires all contractors, consultants, vendors, and their employees working on or entering the MSU-Bozeman campus to register for the Emergency and Public Safety Alert System. The link to register is: <http://www.montana.edu/msualert/>.

**END OF SUPPLEMENTARY GENERAL CONDITIONS**

## **Cost Estimate to Re-key Buildings**

Access to campus buildings is controlled for safety and security reasons. As a key holder the contractor is responsible for following processes associated with maintaining the integrity of our access control program. If a key is lost the contractor is liable for costs associated with ensuring access control is maintained. In some cases that requires re-keying an entire building or key sequence. Cost can range from \$2,000 to over \$200,000 depending on building and key hierarchy.

## SECTION 011000 SUMMARY

### 1.1 PART 1 - GENERAL

#### A. Related Documents

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

#### B. Project Description

1. The project consists of two laboratory renovations in basement room 008 and second floor room 234 of Barnard Hall, located on the property of Montana State University in Bozeman. It includes selective demolition of both rooms 008 and 234. Existing equipment and furnishings removed from room 008 and relocated to room 234 to be coordinated with the owner and the owner's third-party movers. Accommodations to include any necessary transition period which would allow owner equipment relocation. In the basement room 008, a new opening will be created in an existing wall. The existing room 008 entrance door will be relocated. An existing fume hood will be removed from room 008 and relocated to room 008F and a new fume hood will be added to room 008. Work will include new ventilation and ductwork for both fume hoods connecting through first floor room 136 to the roof with roof mounted equipment. Work in room 008 includes new walls, new ceilings, new interior viewing windows and a new closet door and hardware. A new structural suspended ceiling grid with clean room ceiling tiles, suspended shelves and a laser curtain enclosure with attached track and laser curtain will be installed around the owner's optic tables. Suspended shelves will be installed over the owner's glove box train. New casework and counters will be installed in room 008 and 008D. A new sink will be added. New luminaires and under cabinet and under shelf lighting will be added to room 008. Work in room 234 will include new casework and counters. Under cabinet lighting will be installed in new casework. A shelf and thermostat will be relocated. Mechanical, electrical and plumbing services will be upgraded for new services and equipment in both rooms.

#### C. Site Information

1. Scope of work includes, but is not necessarily limited to work on the basement, first and second floor.

#### D. Contracts

1. Contracts shall be under one General Contract and shall include, but not be limited to, all labor, materials, and supervision necessary to furnish and install the Work.

#### E. Work Sequence

1. The work will be conducted in One (1) phase to provide the least possible interference to the activities of the Owner's personnel and activities.
2. The Contractor will have access to the site from the date of receipt of the contract.

F. Contractor Use of Premises

1. Work on this contract is expected to be done during regular working hours Monday through Friday. Any variation from this will require prior approval of the Consultant and Owner.
2. All work must be coordinated with MSU at all times and MSU must be informed about any work impacting campus operations 72 hours or 3 working days in advance of work being conducted and shall require MSU approval.
3. General: Limit use of the premises to construction activities in areas indicated; allow for Owner/MSU occupancy and use by the public. Confine operations to areas within contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.
4. Contractor shall conduct all his work in such a manner as to minimize the inconvenience and disruption of MSU's daily schedule.
5. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.
6. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials to the areas designated on the drawings. If additional storage is necessary, obtain and pay for such storage off-site.
7. Contractor shall establish a staging area for storage of materials and equipment.
8. The Contractor is to coordinate with MSU for the location of the job site trailer office.
9. Keep driveways and entrances serving the premises clear and available to MSU and MSU's employees, staff and visitors at all times, unless otherwise agreed by MSU. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

G. Parking and Site Access

***(See also Supplemental Conditions of the Contract for Construction.)***

1. MSU Bozeman Vehicle Regulations state: "All students, faculty, staff, and visitors must register any motor vehicle they park on the University campus, for any reason. A visitor is anyone not defined as student, staff or faculty."
2. All Contractor and Contractor employees shall comply with Montana State University parking regulations. MSU parking permits can be purchased at the University Police Office located in the Huffman Building at Seventh Avenue and Kagy Boulevard. Violators of MSU Bozeman Vehicle Regulations may be ticketed and towed.
3. A maximum of three (3) Contractor Permits (or as agreed with MSU) will be made available to the Contractor for parking of essential vehicles within the designated parking lot (as designated on the Cover Sheet of the Contract Documents). Essential vehicles are vehicles used for delivery of equipment and tools required to be parked in close proximity to the construction area. All allowed vehicles only to be parked on hard surfaced areas within the Staging Area. All other Contractor and



Contractor employee vehicles on campus shall be parked in designated parking lots to be agreed with MSU. No personal vehicles shall be parked at the project site in any event. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter move to a designated lot or leave campus.

4. Access and egress to and from the project site shall be coordinated with the owner. In cases where a different route must be used for a specific purpose, permission must be obtained from MSU. Access routes are for delivery of equipment, tools, and materials and not for parking.
5. The site Staging Areas for materials and equipment are designated on the Cover Sheet of the Contract Documents. Staged materials and equipment must be secured on the ground surface or in trailers. Site staging areas shall be fenced in accordance with the Contract Documents. Vehicles in addition to those allowed to be parked may not be used for staging of equipment, tools, or materials.

#### H. Owner Occupancy

1. Full Owner/MSU Occupancy: The Owner/MSU will occupy the site during the entire construction period. Cooperate with MSU during construction operations to minimize conflicts and facilitate MSU usage. Perform the work so as not to interfere with MSU's operations.

#### I. Safety Requirements

1. General: The safety measures required by the Contract Documents are not meant to be inclusive. The Contractor shall be solely responsible for safety on a 24-hours-per-day, 7 days-per-week basis and shall take whatever additional measures are necessary to insure the health and safety of the buildings' occupants, or pedestrians at or near the construction site and access routes and of all other persons in all areas affected by the Contractor's activities. Prior to the start of construction, the Contractor is to submit to the Consultant, a detailed written plan specifying the safety procedures that will be followed. Include (but not by way of limitation) the following: Verbiage, size and locations of warning signs; construction sequence as related to safety; use of barricades (type and location); employee policies as related to safety; and delivery of materials as related to safety. Revise the safety plan as required during construction and resubmit to the Owner.
2. All application, material handling, and associated equipment shall conform to and be operated in conformance with OSHA safety requirements.
3. Comply with Federal, State, local, and the Owner's fire, health and safety requirements.
4. Advise MSU whenever work is expected to be hazardous or inconvenient (including objectionable odors) to MSU's employees, students, visitors or the building occupants.
5. Construction materials or equipment shall be placed so as not to endanger the work or prevent free access to all emergency devices or utility disconnects.
6. Maintain the proper rated fire extinguishers within easy access where power tools, sanding or other equipment is being used.

7. The Contractor shall erect and maintain, as required by law, conditions and progress of the work, warning signs, barricades and other reasonable safeguards for safety and protection.

8. **Emergency and Public Safety Alert System:**

Montana State University has an Emergency and Public Safety Alert System that warns the campus community in the event of an emergency or public safety event. Because contractors, consultants, and vendors are considered members of the campus community when working on campus, they must be familiar with the alert system and understand when the system is used. Montana State University requires all contractors, consultants, vendors, and their employees working on or entering the MSU-Bozeman campus to register for the Emergency and Public Safety Alert System. The link to register is:

<http://www.montana.edu/msualert/>

J. Existing Premises Condition

1. The Contractor is responsible for adequately documenting in photos the existing condition of the premises, to include external road surfaces, curbing and landscaped areas, specifically the cleanliness of areas. Any damage to the premises which is found after construction and is not so documented will be the responsibility of the Contractor to repair or replace.

K. Discrepancies in the Documents

1. The Contractor shall bring any discrepancies between any portions of the drawings and specifications to the attention of the Owner and the Consultant in writing. The Owner and Consultant shall review the discrepancy and clarify the intent desired in the Contract Documents. Unless specifically directed otherwise, the Contractor shall be obligated to provide the greater quantity or quality without any change in contract sum or time.

END OF SECTION 011000

**SECTION 012000  
PRICE AND PAYMENT  
PROCEDURES**

1.1 GENERAL

A. Related Documents

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

B. Summary

1. This Section specified administrative and procedural requirements governing the Contractor's Applications for Payment.
2. The Contractor's Construction Schedule and Submittal Schedule are included in Section "Submittals".

C. Schedule of Values

1. Coordinate preparation of the Schedule of Values, Form 100, with preparation of the Contractor's Construction Schedule.
2. Each prime Contractor shall coordinate preparation of its Schedule of Values for its part of the work with preparation of the Contractor's Construction Schedule.
3. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
  - a. Contractor's construction schedule
  - b. Application for Payment form
  - c. List of subcontractors
  - d. Schedule of allowances
  - e. Schedule of alternates
  - f. List of products
  - g. List of principal suppliers and fabricators
  - h. Schedule of submittals
  - i. Submit the Schedule of Values to the Architect at the earliest feasible date, but in no case later than seven (7) days before the date scheduled for submittal of the initial Application for Payment.
  - j. Sub-Schedules: Where the work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
4. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.
  - a. Identification: Include the following project identification on the Schedule of Values:
    - 1) Project name
    - 2) Name of the Architect
    - 3) Project number (PPA No.)
    - 4) Contractor's name and address
    - 5) Date of submittal

b. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

- 1) Generic name
- 2) Related specification section
- 3) Name of subcontractor
- 4) Name of manufacturer or fabricator
- 5) Name of supplier
- 6) Change Orders (numbers) that have affected value
- 7) Dollar value

a) Percentage of Contract Sum in the nearest one-hundredth percent, adjusted to total 100%

c. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

d. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

e. For each part of the work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the work.

5. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

a. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

6. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

D. Applications for Payment

1. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

2. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

3. Payment Application Forms: Use Montana Form 101 as the form for Application for Payment.

4. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

- a. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
  - b. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
5. Transmittal: Submit one (1) executed copy of each Application for Payment to the Architect by means ensuring receipt within 24 hours, including waivers of lien and similar attachments, when required.
- a. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.
6. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
- a. List of subcontractors
  - b. Schedule of Values
    - 1) Contractor's Construction Schedule (preliminary if not final)
  - c. Copies of building permits
    - 1) Copies of authorizations and licenses from governing authorities for performance of the work
  - d. Certificates of insurance and insurance policies (submitted with Contract)
  - e. Performance and payment bonds (submitted with Contract if required)
7. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the work.
8. Administrative actions and submittals that shall proceed or coincide with this application include:
- a. Occupancy permits and similar approvals
  - b. Warranties (guarantees) and maintenance agreements
  - c. Test/adjust/balance records
  - d. Maintenance instructions
  - e. Meter readings
  - f. Start-up performance reports
    - 1) Change-over information related to Owner's occupancy, use, operation and maintenance.
  - g. Final cleaning
    - 1) Application for reduction of retainage, and consent of surety

9. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final Application for Payment include the following:
- a. Completion of project closeout requirements
    - 1) Completion of items specified for completion after Substantial Completion
  - b. Assurance that unsettled claims will be settled
    - 1) Assurance that work not complete and accepted will be completed without undue delay
    - 2) Transmittal of required project construction records to Owner

END OF SECTION 01200

## **SECTION 012300 ALTERNATES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions, Supplemental Conditions and other Division 1 Specification Sections, apply to this section. See also *Instructions to Bidders 10.3 Award of Bids*.

#### **1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements for alternates.

#### **1.3 DEFINITIONS**

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

#### **1.4 PROCEDURES**

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

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

**PART 3 - EXECUTION**

**3.1 SCHEDULE OF ALTERNATES**

- A. Alternate 1: Fluid-Applied Flooring
  - 1. Provide an additive price to furnish and install a Fluid-Applied Flooring system as specified in Section 096700 Fluid Applied Flooring in lieu of applying the Concrete Floor Finish as specified in Section 033511 Concrete Floor Finishes.
  
- B. Alternate 2: Domestic Water Backup System
  - 1. Provide a deductive price to delete the Domestic Water Backup system in its entirety as shown in details 18/M9.0 and 17/P9.1 and any associated notes and details.

**END OF SECTION**



**SECTION 012500  
SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

- A. Related Documents
  - 1. Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions and *Instructions to Bidders*.
  
- B. Substitution Procedures
  - 1. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by the Contractor.
  - 2. Substitution Requests: Submit three copies of each request on MSU Substitution Request Form 099 for each consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
    - a. Submit requests in accordance with *Instructions to Bidders*.
    - b. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.
  
- C. Architect will review proposed substitutions and notify Contractor of their acceptance or rejection. If necessary, Architect will request additional information or documentation of evaluation.
  - 1. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
  
- D. Do not submit unapproved substitutions on Shop Drawings or other submittals.

**END OF SECTION 012500**



**SECTION 01 26 00**  
**CONTRACT MODIFICATION PROCEDURES**

**PART 1 GENERAL**

**1.1 RELATED REQUIREMENTS**

- A. Division 1 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
- B. Division 1 Section "Submittals" for requirements for the Contractor's Construction Schedule.
- C. Division 1 Section "Payment Procedures" for administrative procedures governing applications for payment.
- D. Division 1 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after award of the Contract.
- E. Division 1 Section "Closeout Requirements" for procedures for maintaining Bulletins and Sketches as part of the Record Set.

**1.2 DEFINITIONS**

- A. Bulletin:
  - 1. A Bulletin is a written directive prepared by the Architect, issued to the Contractor, to modify the Construction Documents for one of the following reasons:
    - a. Document Clarification(s).
    - b. Field Condition(s).
    - c. Proposed Change(s) to the Work.
    - d. Owner-Authorized Change(s) to the Work.
  - 2. All Bulletins will be dated and numbered in order. The Bulletins will describe proposed change(s) in the Work and will carry appropriate instructions to the Contractor. If the Architect prepares a Sketch, a Bulletin will be issued with the Sketch indicating the Sketch number and generally describing the content of the Sketch.
- B. Change Order:
  - 1. A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor & Architect stating their agreement upon all of the following:
    - a. A change in the work;
    - b. The amount of the adjustment in the Contract Sum, if any; and
    - c. The extent of the adjustment in the Contract Time, if any.
  - 2. Methods used in determining adjustments to the Contract Sum may include those specified herein. All Change Orders will be dated and numbered in sequence. The Change Order will refer to the Bulletin or Bulletins involved and will include Contractors and Subcontractors full back-up data.

**1.3 CHANGES TO THE WORK**

- A. Changes to the work may be accomplished after execution of the Contract and without invalidating the contract by the following means: 1) by Bulletin alone, if the changes are minor and do not result in an adjustment to Project Sum or Time or 2) by Change Order. All changes to the work are subject the limitations stated in the General and Supplementary Conditions, in this section and elsewhere in the Contract Documents.
- B. Changes in the work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order or Bulletin.

**1.4 SUBMITTALS**

- A. Make submittals directly to the Architect.
- B. Submit the number of copies called for under the various items listed in this Section.

### **1.5 QUALITY ASSURANCE**

- A. Include within the Contractor's quality assurance program such measures as are needed to assure familiarity of the Contractor's staff and employees with these procedures for processing Change Order and Bulletin data.

### **1.6 RECORDS**

- A. The Architect will maintain separate "Logs" of Bulletins and Change Orders, accurately reflecting current status of all pertinent data. Any sketches or revised drawings issued by the Architect will be tracked, with their corresponding Bulletin(s), in the Bulletin Log.
- B. The Architect will make copies of the Logs available to the Owner and Contractor at project progress meetings in order to keep both parties informed as to the status of all Bulletins and Change Orders.

### **1.7 BULLETINS**

- A. Preparing Bulletins:
  - 1. Proposed Changes:
    - a. Should the Owner, Contractor or Architect propose making a change in the Work or a change in the Contract Time of Completion, the Architect will issue a Bulletin to the Contractor with the following instructions:
      - 1) This Bulletin describes a Proposed Change to the Work which may affect the Contract Sum or Contract Time. The Contractor is requested to respond to the Bulletin in writing to the Architect within 10 working days from the above date. This Bulletin is neither an authorization nor a directive to change the work.
    - b. The Contractor shall make prompt written reply to the Architect in response to the Bulletin per the requirements specified herein, within the number of days specified in the Bulletin.
    - c. The Architect shall promptly advise the Contractor as to whether the cost or credit for the change in Contract Sum or Time, has been agreed to by the Owner. The Architect will issue a "Change Order" to the Contractor in accordance with the requirements specified herein.
    - d. The Contractor shall proceed with the change in the Work.
  - 2. Owner-Authorized Changes
    - a. Should the Owner direct a change in the work or time of completion, prior to the determination by the Contractor as to the effect of such change on the Contract Sum or Time, the Architect will issue a Bulletin with the following instructions:
      - 1) This Bulletin describes an Owner-Authorized Change to the Work which may affect the Contract Sum or Contract Time. The Contractor is requested to respond to the Bulletin in writing to the Architect within 10 working days from the above date. This Bulletin is an authorization and a directive to change the work.
    - b. The Contractor shall proceed with the changes described in the Bulletin. In addition, the Contractor shall make prompt written reply to the Architect in response to the Bulletin per the requirements specified herein, within the number of days specified in the bulletin.
    - c. When cost or credit for the change in Contract Sum or Time, has been agreed upon by the Owner and Contractor, the Architect will issue a "Change Order" to the Contractor in accordance with the requirements specified herein.
  - 3. Minor Changes to the Work

- a. Should the Architect direct a minor change in the work due to Document Clarification(s), Field Condition(s), or acceptance of a Product Substitution, the Architect will issue a Bulletin to the Contractor. A Bulletin issued for any of these purposes assumes that there is no effect on Contract Sum or Time resulting from the Bulletin. As an example, the Bulletin for a Document Clarification, will carry the following instructions:
  - 1) This Bulletin describes a Document Clarification which may affect the Contract Sum or Contract Time. The Contractor is requested to respond to this Bulletin in writing to the Architect within 10 working days from the above date. This Bulletin is an authorization and a directive to change the Work.
- b. If there is no effect on the Contract Sum or Time, the Contractor shall proceed with the changes described in the Bulletin. A change order will not be issued.
- c. If, in the Contractor's opinion, the changes described in the Bulletin do affect the Contract Sum or Time, the Contractor shall promptly notify the Architect, and shall not proceed with the changes. The Owner and Architect will assess the Contractor's claim and promptly render a decision. Upon agreement by the Owner and Architect that there is reasonable cause for adjustment to the Contract Sum or Time, the Architect will issue a Change Order in accordance with the requirements specified herein.

**B. Processing Bulletins:**

1. The Contractor shall make written reply to the Architect in response to each Bulletin. The written reply should:
  - a. State proposed change in the Contract Sum, if any.
  - b. State proposed change in the Contract Time of Completion, if any.
  - c. Clearly describe other changes in the Work required by the proposed change, or desirable therewith, if any.
  - d. Include full backup data such as Contractor's and Subcontractor's letters of proposal stating labor and material costs and similar information.
2. The Contractor shall make the written reply within the number or days specified in the Bulletin.
3. The Contractor shall alert pertinent personnel and Subcontractors as to the impending change and, to the maximum extent possible, avoid such work as would increase the Owner's cost for making the change, advising the Owner and Architect in writing when such avoidance no longer is possible or convenient.

**1.8 CHANGE ORDERS**

**A. Preparing Change Orders:**

1. The Contractor shall furnish to the Architect four (4) complete sets of backup data or a single PDF digital file for each Change Order.
2. The Architect shall prepare the Change Order cover sheet which will provide an itemized summary of the adjustment(s) to Contract Sum or Time, list the Bulletin number(s) involved and be accompanied by the full back-up data submitted by the Contractor.
3. The Architect will issue four (4) copies of each Change Order, signed by the Architect, to the Contractor.
4. The Contractor shall promptly sign all four (4) copies and return all four (4) to the Architect.
5. The Architect will then forward all four (4) copies to the Owner who will promptly sign all four copies, will retain two (2) copies and forward one (1) copy each to the

Contractor and Architect.

6. If the Contractor finds an error or disagrees with the Change Order as prepared, the Contractor shall promptly return the four (4) copies of the Change Order, unsigned by him, to the Architect with a letter signed by the Contractor identifying the error or stating the reason or reasons for the Contractor's disagreement. The Contractor shall send a copy of the letter to the Owner.
- B. Methods for Determining Adjustments to the Contract Sum:
1. If the Bulletin involves adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
    - a. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
    - b. Unit prices stated in the Contract Documents or subsequently agreed upon;
    - c. Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or the adjustment may be determined by the Architect on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. In such case, the Contractor shall keep and present, an itemized accounting together with appropriate supporting data. Costs shall be limited to the following:
      - 1) Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' or workmen's compensation insurance;
      - 2) Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
      - 3) Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
      - 4) Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
      - 5) Additional costs of supervision and field office personnel directly attributable to the change.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 26 00**

## SECTION 013000

### SUBMITTALS

#### 1.1 GENERAL

##### A. Related Documents

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

##### B. Summary

1. This Section specifies administrative and procedural requirements for submittals required for performance of the work, including:

- a. Contractor's construction schedule
- b. Submittal schedule
- c. Daily construction reports
- d. Shop Drawings
- e. Product data
- f. Samples

Note: All Submittals are to be both print and electronic.

2. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

- a. Permits
- b. Applications for Payment
- c. Performance and payment bonds
- d. Insurance certificates
- e. List of Subcontractors

3. The Schedule of Values submitted is included in Section "Applications for Payment".

4. Inspection and test reports are included in Section "Quality Requirements".

5. Unless otherwise instructed by the Owner all submittals shall be directed to Architect/Engineer Consultant of Record. The Contractor's construction schedule, submittal schedule and daily construction reports shall be directed to the Consultant's representative, the State of Montana's representative and MSU's representative. Shop drawings, product data and samples shall be directed to the Consultant's representative.

##### C. Submittal Procedures

1. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
  - a. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

- b. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.
    - 1) The Consultant reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
  - c. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
    - 1) Allow two (2) weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Consultant will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
    - 2) If an intermediate submittal is necessary, process the same as the initial submittal.
    - 3) Allow two (2) weeks for reprocessing each submittal.
    - 4) No extension of contract time will be authorized because of failure to transmit submittals to the Consultant sufficiently in advance of the work to permit processing.
2. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
- a. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
  - b. Include the following information on the label for processing and recording action taken.
    - 1) Project name and PPA Number
    - 2) Date
    - 3) Name and address of Consultant
    - 4) Name and address of Contractor
    - 5) Name and address of Subcontractor
    - 6) Name and address of supplier
    - 7) Name of manufacturer
      - a) Number and title of appropriate Specification Section
      - b) Drawing number and detail references, as appropriate
3. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Consultant using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
- a. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include



Contractor's certification that information complies with Contract Documents requirements.

- b. Transmittal Form: Contractor's standard form.

D. Contractor's Construction Schedule

1. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit both in print and electronically within thirty (30) days of the date established for "Commencement of the Work".
  - a. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicated in the "Schedule of Values".
  - b. Within each time bar indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate actual completion.
  - c. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
  - d. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work.
  - e. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other schedules.
  - f. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Consultant's procedures necessary for certification of Substantial Completion.
2. Work Stages: Indicate important stages of construction for each major portion of the Work, including testing and installation.
3. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the work. Indicate where each element in an area must be sequenced or integrated with other activities.
4. Cost Correlation: At the head of the schedule, provide a two (2) item cost correlation line, indicating "pre-calculated" and "actual" costs. On the line show dollar-volume of work performed as of the dates used for preparation of payment requests.
  - a. Refer to Section "Price and Payment Procedures" for cost reporting and payment procedures.
5. Distribution: Following response to the initial submittal, print and distribute copies to the Consultant, Owner, subcontractors, and other parties required to comply with scheduled dates. Transmit electronically and post copies in the project meeting room and temporary field office.
  - a. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have

completed their assigned portion of the work and are no longer involved in construction activities.

6. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule electronically and in print concurrently with report of each meeting.

E. Submittal Schedule

1. After development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals. Submit the schedule within ten (10) days of the date required for establishment of the Contractor's construction schedule.

- a. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products, as well as the Contractor's construction schedule.
- b. Prepare the schedule in chronological order; include submittals required during the first thirty (30) or sixty (60) days of construction. Provide the following information:

- 1) Scheduled date for the first submittal
- 2) Related section number
- 3) Submittal category
- 4) Name of subcontractor
- 5) Description of the part of the work covered
- 6) Scheduled date for resubmittal
  - a) Scheduled date the Consultant's final release or approval

2. Distribution: Following response to initial submittal, print and distribute copies to the Consultant, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.

- a. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in construction activities.

3. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

F. Daily Construction Reports

1. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Consultant at weekly intervals:

- a. List of subcontractors at the site
- b. Approximate count of personnel at the site
- c. High and low temperatures, general weather conditions
- d. Accidents and unusual events
- e. Meetings and significant decisions

- f. Stoppages, delays, shortages, losses
  - g. Meter readings and similar recordings
  - h. Emergency procedures
  - i. Orders and requests of governing authorities
  - j. Change Orders received, implemented
  - k. Services connected, disconnected
  - l. Equipment or system tests and start-ups
  - m. Partial completions, occupancies
  - n. Substantial Completions authorized
- G. Shop Drawings
1. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the project is not considered Shop Drawings.
  2. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
    - a. Dimensions
    - b. Identification of products and materials included
    - c. Compliance with specified standards
    - d. Notation of coordination requirements
    - e. Notation of dimensions established by field measurement
    - f. Sheet Size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2" x 11", but no larger than 36" x 48".
    - g. Submittal: Submit electronically and in print for the Consultant's review; Consultant's comments will be returned electronically.
      - 1) One (1) of the prints returned shall be marked-up and maintained as a "Record Document".
    - h. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
  3. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
    - a. Preparation of coordination drawings is specified in section "Project Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
    - b. Submit coordination drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.
- H. Product Data
1. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's

installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings".

- a. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
  - 1) Manufacturer's printed recommendations
    - a) Compliance with recognized trade association standards
    - b) Compliance with recognized testing agency standards
  - 2) Application of testing agency labels and seals
    - a) Notation of dimensions verified by field measurement
  - 3) Notation of coordination requirements
- b. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- c. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.
- d. Submittals: Submit two (2) copies of each required submittal; submit four (4) copies where required for maintenance manuals. The Consultant will retain one (1), and will return the other marked with action taken and corrections or modifications required.
  - 1) Unless non-compliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
- e. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
  - 1) Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
  - 2) Do not permit use of unmarked copies of Product Data in connection with construction.

#### I. Samples

1. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
  - a. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to match the Consultant's sample. Include the following:
    - 1) Generic description of the sample
    - 2) Sample source
    - 3) Product name or name of manufacturer

- 4) Compliance with recognized standards
  - 5) Availability and delivery time
2. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
    - a. Where variation in color, pattern, texture, or other characteristics are inherent in the material or product represented, submit multiple units (not less than three (3)), that show approximate limits of the variations.
    - b. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
    - c. Refer to other sections for samples to be returned to the Contractor for incorporation in the work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
  3. Preliminary Submittals: Where samples are for selection of color, pattern, texture, or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
    - a. Preliminary submittals will be reviewed and returned with the Consultant's mark indicating selection and other action.
  4. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit three (3) sets; one (1) will be returned marked with the action taken.
    - a. Maintain sets of samples, as returned, at the project site, for quality comparisons throughout the course of construction.
      - 1) Unless non-compliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
      - 2) Sample sets may be used to obtain final acceptance of the construction associated with each set.
  5. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the work. Show distribution on transmittal forms.
    - a. Field samples specified in individual sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.
      - 1) Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

J. Consultant's Action

1. Except for submittals for record, information, or similar purposes, where action and return is required or requested, the Consultant will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.
2. Action Stamp: The Consultant will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
  - a. Final-But-Restricted Release: When submittals are marked "Make Corrections Noted", that part of the work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
  - b. Returned for Resubmittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
    - 1) Do not permit submittals marked "Revise and Resubmit" to be used at the project site, or elsewhere where work is in progress.
  - c. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action not Required".

END OF SECTION 013000

**SECTION 013100  
PROJECT COORDINATION**

**1.1 GENERAL**

- A. Related Documents
  - 1. Drawings and general provisions of Contract, including General Conditions and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.
  
- B. Summary
  - 1. This section specifies administrative and supervisor requirements necessary for project coordination including, but not necessarily limited to:
    - a. Coordination
    - b. Administrative and supervisory personnel
    - c. General installation provisions
    - d. Cleaning and protection
  - 2. Field Engineering is included in Section "Field Engineering".
  - 3. Progress meetings, coordination meetings and pre-installation conferences are included in Section "Project Meetings".
  - 4. Requirements for Contractor's Construction Schedule are included in Section "Submittals".
  
- C. Coordination
  - 1. Coordination: Coordinate construction activities included under various sections of these specifications to assure efficient and orderly installation of each part of the work. Coordinate construction operations included under different sections of the specifications that are dependent upon each other for proper installation, connection, and operation.
    - a. Provide access to work at all times for inspections by Owner and authorized representatives.
    - b. Provide safe working conditions and protection of completed work.
    - c. Provide barricades and signs.
    - d. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
    - e. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
    - f. Make adequate provisions to accommodate items scheduled for later installation.
    - g. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
      - 1) Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.
  - 2. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

- a. Notify Facilities Services or Campus Planning, Design and Construction of any expected disruptions in service or changes in construction schedule at least 72 hours (3 working days) in advance.
  - b. Preparation of schedules.
  - c. Installation and removal of temporary facilities.
  - d. Delivery and processing of submittals.
  - e. Progress meetings.
  - f. Project close-out activities.
3. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
- a. Salvage materials and equipment involved in performance of, but not actually incorporated in, the work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.
- D. Submittals
- 1. Coordinated Drawings: Prepare and submit coordination drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
    - a. Show the interrelationship of components shown on separate shop drawings.
    - b. Indicate required installation sequences.
    - c. Comply with requirements contained in Section "Submittals".
    - d. Section "Basic Electrical Requirements" for specific coordination drawing requirements for mechanical and electrical installations.
  - 2. Staff Names: Within 15 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

## 1.2 PROJECT MEETINGS

- A. Related Documents
- 1. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Summary
- 1. This section specifies administrative and procedural requirements for project meetings including but not limited to:
    - a. Pre-construction conference
    - b. Pre-installment conferences
    - c. Coordination meetings
    - d. Progress meetings
- C. Pre-construction Conference
- 1. Schedule a pre-construction conference and organizational meeting.
    - a. Hold meeting at the project site or other convenient location and prior to commencement of construction activities, including the moving of



equipment on to the site. Conduct the meeting to review responsibilities and personnel assignments.

2. Attendees: The Owner, Consultant and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work. Both the Contractor and the Contractor's job foremen shall attend the meeting, along with all subcontractors.
3. Agenda: Discuss items of significance that could affect progress including such topics as:
  - a. Tentative construction schedule
  - b. Critical work sequencing
  - c. Designation of responsible personnel
  - d. Procedures for processing field decisions and Change Orders
  - e. Procedures for processing Applications for Payment
  - f. Distribution of Contract Documents
  - g. Submittal of Shop Drawings, Product Data and Samples
  - h. Preparation of record documents
  - i. Use of the premises
  - j. Office, work and storage areas
  - k. Equipment deliveries and priorities
  - l. Safety procedures
  - m. First aid
  - n. Security
  - o. Housekeeping
  - p. Working hours

D. Pre-Installation Conferences

1. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Consultant of scheduled meeting dates.
2. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
  - a. Contract Documents
  - b. Options
  - c. Related Change Orders
  - d. Purchases
  - e. Deliveries
  - f. Shop Drawings, Product Data and quality control samples
  - g. Possible conflicts
  - h. Compatibility problems
  - i. Time schedules
  - j. Weather limitations
  - k. Manufacturer's recommendations
  - l. Compatibility of materials
  - m. Acceptability of substrates
  - n. Temporary facilities
  - o. Space and access limitations
  - p. Governing regulations

- q. Safety
  - r. Inspection and testing requirements
  - s. Required performance results
  - t. Recording requirements
  - u. Protection
3. The Consultant will record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Consultant.
  4. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene the conference at the earliest feasible date.
- E. Coordination Meeting
1. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.
  2. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.
  3. The Consultant will record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
- F. Progress Meetings
1. Conduct progress meetings at the project site at regularly scheduled intervals. Coordinate with the Owner and Consultant of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
  2. Attendees: In addition to representatives of the Owner and Consultant, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.
  3. Agenda: Visit job site to raise specific pending issues prior to meeting. Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the contract time.
    - b. Review the present and future needs of each entity present, including such items as:
      - 1) Interface requirements
      - 2) Time
      - 3) Sequences
      - 4) Deliveries
      - 5) Off-site fabrication problems
      - 6) Access
      - 7) Site utilization

- 8) Temporary facilities and services
  - 9) Hours of work
  - 10) Hazards and risks
  - 11) Housekeeping
  - 12) Quality and work standards
  - 13) Change Orders
  - 14) Documentation of information for payment requests
4. Reporting: The Consultant shall distribute printed and electronic copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- a. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

### **1.3 PRODUCTS (NOT APPLICABLE)**

### **1.4 EXECUTION**

#### **A. General Installation Provisions**

1. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
2. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
3. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
4. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
5. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Consultant for final decision.
6. Recheck measurements, quantities and dimensions, before starting each installation.
7. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
8. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
9. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated and in compliance with accessibility requirements. Refer questionable mounting height decisions to the Consultant for final decision.

#### **B. Cleaning and Protection**

1. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

2. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
3. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
  - a. Excessive static or dynamic loading
  - b. Excessive internal or external pressures
  - c. Excessively high or low temperatures
  - d. Thermal shock
  - e. Excessively high or low humidity
  - f. Air contamination or pollution
  - g. Water or ice
  - h. Solvents
  - i. Chemicals
  - j. Light
  - k. Radiation
  - l. Puncture
  - m. Abrasion
  - n. Heavy traffic
  - o. Soiling, staining and corrosion
  - p. Bacteria
  - q. Rodent and insect infestation
  - r. Combustion
  - s. Electrical current
  - t. High speed operation
  - u. Improper lubrication
  - v. Unusual wear or other misuse
  - w. Contact between incompatible materials
  - x. Destructive testing
  - y. Misalignment
  - z. Excessive weathering
    - aa. Unprotected storage
    - ab. Improper shipping or handling
    - ac. Theft
    - ad. Vandalism

**END OF SECTION 013100**

## SECTION 014000 QUALITY REQUIREMENTS

### 1.1 GENERAL

#### A. RELATED DOCUMENTS

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

#### B. SUMMARY

1. This Section specifies administrative and procedural requirements for quality control services.
2. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.
3. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
4. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
  - a. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
  - b. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
  - c. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

#### C. RESPONSIBILITIES

1. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services, specified in individual Specification Sections and required by governing authorities, except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity; these services include those
  - a. Services specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the Contract Sum.
  - b. The Contractor shall employ and pay an independent agency, to perform specified quality control services.
  - c. The Owner will engage and pay for the services of an independent agency

- to perform inspections and tests specified as the Owner's responsibility. Payment for these services will be made by the Owner.
- d. Where the Owner has engaged a testing agency or other entity for testing and inspection of a part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner, unless otherwise agreed in writing with the Owner.
2. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services provide unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.
    - a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.
  3. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Associated services required include but are not limited to:
    - a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
    - b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
    - c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
    - d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
    - e. Security and protection of samples and test equipment at the Project site.
  4. Owner Responsibilities: The Owner will provide inspections, tests and similar quality control services specified to be performed by independent agencies and not by the Contractor, except where they are specifically indicated as the Contractor's responsibility or are provided by another identified entity. Costs for these services are not included in the Contract Sum.
    - a. The Owner will employ and pay for the services of an independent agency, testing laboratory or other qualified firm to perform services which are the Owner's responsibility.
  5. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
    - a. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

- b. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
  - c. The agency shall not perform any duties of the Contractor.
6. Coordination: The Contractor and each agency engaged to perform inspections, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

#### D. SUBMITTALS

- 1. The independent testing agency shall submit a certified written report and electronic copy of each inspection, test or similar service, to the Architect, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, submit a certified written report of each inspection, test or similar service through the Contractor, in duplicate.
  - a. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
  - b. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:
    - 1) Date of issue
    - 2) Project title and number
    - 3) Name, address and telephone number of testing agency
    - 4) Dates and locations of samples and tests or inspections
    - 5) Names of individuals making the inspection or test
    - 6) Designation of the Work and test method
    - 7) Identification of product and Specification Section
    - 8) Complete inspection or test data
    - 9) Test results and in interpretations of test results
    - 10) Ambient conditions at the time of sample-taking and testing
    - 11) Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements
    - 12) Name and signature of laboratory inspector
    - 13) Recommendations on retesting

#### DI. QUALITY ASSURANCE

- 1. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
- 2. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State of Montana.

1.2 PRODUCTS (NOT APPLICABLE)

1.3 EXECUTION

A. GENERAL

1. Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
2. Protect construction exposed by or for quality control service activities, and protect repaired construction.
3. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

**END OF SECTION 014000**



**SECTION 015000  
TEMPORARY FACILITIES AND UTILITIES**

1.1 GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.
2. Temporary utilities required may include but are not limited to:
  - a. Telephone service
  - b. Electric Service
  - c. Water
  - d. Natural gas
  - e. Sewer
3. Temporary construction and support facilities required may include but are not limited to:
  - a. Field offices and storage sheds.
  - b. Sanitary facilities, including drinking water
  - c. Temporary Project identification signs and bulletin boards
  - d. Waste Disposal services
  - e. Construction aids and miscellaneous services and facilities
4. Security and protection facilities required include but are not limited to:
  - a. Temporary Security Fencing
  - b. Temporary fire protection
  - b. Barricades, warning signs, lights
  - c. Environmental protection

C. QUALITY ASSURANCE

1. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
  - a. Building Code requirements
  - b. Health and safety regulations
  - c. Utility company regulations
  - d. Police, Fire Department and Rescue Squad rules
  - e. Environmental protection regulations
2. Standards: Comply with NFPA Code 241, "Building Construction and

Demolition Operations" and ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

D. PROJECT CONDITIONS

1. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

1.2 PRODUCTS

A. MATERIALS

1. General: Provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
2. Water: Provide potable water approved by local health authorities.
3. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel pipe posts, 1 1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.

B. EQUIPMENT

1. General: Provide new equipment; if acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
2. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.
3. Electrical Outlets: Provide properly configured NEA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
4. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.
5. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
6. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
7. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

9. First Aid Supplies: Comply with governing regulations.
10. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.
  - a. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

### 1.3 EXECUTION

#### A. INSTALLATION

1. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work and Owner's operations. Relocate and modify facilities as required.
2. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

#### B. TEMPORARY UTILITIES

1. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Provide cellular telephone, operational and on site at all times.

#### C. TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

1. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access and minimal interruption to Owner's operations.
  - a. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
2. Field Offices: The Contractor, at his option, shall provide insulated, weather tight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:
  - a. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table and plan rack and a 6-shelf bookcase.
  - b. Equip with a water cooler and private toilet complete with water closet, lavatory and mirror-medicine cabinet unit.
3. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved,

including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

4. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
  - a. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.
5. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
6. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
  - a. Provide safety showers, eye-wash fountains and similar facilities for convenience, safety and sanitation of personnel.
7. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper supply.
  - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F (7 to 13 deg C).
8. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg. F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner. Do not use University trash containers for any reason.

#### D. SECURITY AND PROTECTION FACILITIES INSTALLATION

1. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - (a) Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
3. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel

pipe posts, 1 1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.

4. Barricades, Warning Signs and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
5. Do not remove temporary security and protection facilities until Substantial Completion, or longer as requested by the Architect.
6. Temporary Fire Protection: Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."
  - a. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
  - b. Store combustible materials in containers in fire-safe locations.
  - c. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
  - d. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
7. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

#### E. OPERATION, TERMINATION AND REMOVAL

1. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
2. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
3. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
  - a. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

END OF SECTION 015000



## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplemental Conditions and Division 1 Specification Sections, apply to this section.

#### 1.2 SECTION REQUIREMENTS

- A. Provide products of same kind from a single source. The term "product" includes the terms "material," "equipment," "system," and similar terms.
- B. Deliver, store, and handle products according to manufacturer's written instructions, using means and methods that will prevent damage, deterioration, and loss, including theft.
  - 1. Inspect products at time of delivery for compliance with the Contract Documents and to ensure items are undamaged and properly protected.
- C. Product Substitutions: Reasonable and timely requests for substitutions will be considered. Substitutions include products and methods of construction differing from that required by the Contract Documents and proposed by Contractor after award of Contract. Substitutions only allowed for products when more than one manufacturer is indicated.
  - 1. Submit two (2) copies of each request for product substitution. Identify product to be replaced and provide complete documentation showing compliance of proposed substitution with applicable requirements. Include a full comparison with the specified product, a list of changes to other Work required to accommodate the substitution, and any proposed changes in Contract Sum or Contract Time should the substitution be accepted.
  - 2. Submit requests for product substitution in time to permit processing of request and subsequent Submittals, if any, sufficiently in advance of when materials are required in the Work. Do not submit unapproved substitutions on Shop Drawings or other submittals.
  - 3. Owner will review the proposed substitution and notify Contractor of its acceptance or rejection.

### PART 2 - PRODUCTS

#### 2.1 PRODUCT OPTIONS

- A. Provide products that comply with the Contract Documents, are undamaged, and are new at the time of installation.
  - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.

B. Select products as follows:

1. Where only a single product or manufacturer is named, provide the item indicated. No substitutions will be permitted.
2. Where two or more products or manufacturers are named, provide one of the items indicated. No substitutions will be permitted.
3. Where products or manufacturers are specified by name, accompanied by the term "or equal," provide the named item or comply with provisions concerning "product substitutions" to obtain approval for use of an unnamed product or manufacturer.
4. Where a product is described with required characteristics, with or without naming a brand or trademark, provide a product that complies with those characteristics and other Contract requirements.
5. Where compliance with performance requirements is specified, provide products that comply and are recommended in writing by the manufacturer for the application.
6. Where compliance with codes, regulations, or standards, is specified, select a product that complies with the codes, regulations, or standards referenced.

C. Unless otherwise indicated, Owner will select color, pattern, and texture of each product from manufacturer's full range of options.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 016000



**SECTION 01 61 16**  
**VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.
- C. Requirement for installer certification that they did not use any non-compliant products.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 30 00 - Administrative RequirementsSubmittals: Submittal procedures.
- B. Section 01 60 00 - Product Requirements: Fundamental product requirements

**1.3 DEFINITIONS**

- A. A Volatile Organic Compound (VOC) is a carbon compound that participates in atmospheric photochemical reactions. The compounds vaporize (become a gas) at normal room temperatures. Many VOC compounds have been implicated in a variety of health problems for installers and building occupants, ranging from eye, nose, and throat irritation to respiratory problems and cancer with long-term exposure.
- B. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Products making up wall and ceiling assemblies.
  - 5. Thermal and acoustical insulation.
  - 6. Other products when specifically stated in the specifications.
- C. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Other products when specifically stated in the specifications.
- D. Interior of Building: Anywhere inside the exterior weather barrier.
- E. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- F. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- G. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  - 1. Stone.
  - 2. Concrete.
  - 3. Metals that are plated, anodized, or powder-coated.
  - 4. Glass.
  - 5. Ceramics.
  - 6. Solid wood flooring that is unfinished and untreated.

**1.4 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).

- C. BIFMA e3 - Furniture Sustainability Standard; Business and Institutional Furniture Manufacturers Association; 2014.
- D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; 2017, v1.2.
- E. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- F. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- G. CHPS (HPPD) - High Performance Products Database; Current Edition at [www.chps.net/](http://www.chps.net/).
- H. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- I. GreenSeal GS-36 - Adhesives for Commercial Use; 2013.
- J. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- L. SCS (CPD) - SCS Certified Products; Current Edition.
- M. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

#### 1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

#### 1.6 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:

- a. Current SCS "No Added Formaldehyde (NAF)" certification;  
www.scscertified.com.
  - b. Report of laboratory testing performed in accordance with requirements.
  - c. Published product data showing compliance with requirements.
  - d. Certification by manufacturer that product complies with requirements.
- D. Furnishings Emissions Standard and Test Method: BIFMA e3 Sections 7.6.1 and 7.6.2, tested in accordance with BIFMA M7.1.
1. Evidence of Compliance:
    - a. Test report showing compliance and stating exposure scenario used.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  1. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  2. Aerosol Adhesives: GreenSeal GS-36.
  3. Joint Sealants: SCAQMD 1168 Rule.
  4. Paints and Coatings: Each color; most stringent of the following:
    - a. 40 CFR 59, Subpart D.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).

**PART 3 EXECUTION**

**3.1 FIELD QUALITY CONTROL**

- A. Owner and Architect reserve the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner .
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION 01 61 16**



**SECTION  
173000  
EXECUTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Installation of the Work.
3. Cutting and patching.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.

1.3 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Consultant of locations and details of cutting and await directions from Consultant before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or those results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Consultant's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
  - 1. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Consultant for the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a written and email request for information to Consultant.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, promptly notify Consultant by email and in writing.
  - 1. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 2. Inform installers of lines and levels to which they must comply.
  - 3. Check the location, level and plumb, of every major element as the Work progresses.
  - 4. Notify Consultant when deviations from required lines and levels exceed allowable tolerances.
- B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Consultant.

### 3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Consultant, and in compliance with accessibility requirements.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
  - J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- 3.5 CUTTING AND PATCHING
- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
    1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
  - B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
  - C. Temporary Support: Provide temporary support of work to be cut.
  - D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
  - E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
    1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
    2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
    3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond- core drill.
    4. Proceed with patching after construction operations requiring cutting are complete.
  - F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
    1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.



2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste.
  4. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- H. Clean and provide maintenance on completed construction as frequently as necessary through

the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 017300**

**SECTION 017400  
WARRANTIES AND  
BONDS**

1.1 GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.
  - a. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
  - b. General closeout requirements are included in Section "Project Closeout."
  - c. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.
  - d. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
2. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. DEFINITIONS

1. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
2. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

D. WARRANTY REQUIREMENTS

1. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
3. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with

requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.

4. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
  - a. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

#### E. SUBMITTALS

1. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
  - a. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within fifteen days of completion of that designated portion of the Work.
2. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate items and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect for approval prior to final execution.
  - a. Refer to individual Sections of Divisions-2 through -16 for specific content requirements, and particular requirements for submittal of special warranties.
3. Forms of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  1. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
    - a. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a

typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

b. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.

2. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.2 PRODUCTS (NOT APPLICABLE)

1.3 EXECUTION

A. SCHEDULE OF WARRANTIES

1. Schedule: Provide warranties and bonds on products and installations as specified in the appropriate Sections.

**END OF SECTION 017400**



**SECTION 017419  
WASTE MANAGEMENT**

PART 1 - GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

Owner requires that this project generate the least amount of trash and waste possible. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration and shall be recycled:

- Aluminum and plastic beverage containers.
- Corrugated cardboard.
- Wood pallets.
- Clean dimensional wood: May be used as blocking or furring.
- Land clearing debris, including brush, branches, logs, and stumps.
- Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.

Methods of trash/waste disposal that are **not** acceptable are:

- Burning on the project site.
- Burying on the project site.
- Dumping or burying on other property, public or private. Other illegal dumping or burying.

Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 DEFINITIONS

Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form.

Recycling does not include burning, incinerating, or thermally destroying waste.

Return: To give back reusable items or unused products to vendors for credit.

## **SECTION 017320 WASTE MANAGEMENT**

Reuse: To reuse a construction waste material in some manner on the project site.  
Salvage: To remove a waste material from the project site to another site for resale or reuse by others.  
Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.  
Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.  
Toxic: Poisonous to humans either immediately or after a long period of exposure.  
Trash: Any product or material unable to be reused, returned, recycled, or salvaged.  
Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 1.3 WASTE MANAGEMENT PLAN IMPLEMENTATION

Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and the Architect.

Instruction: 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.

Meetings: Discuss trash/waste management goals and issues at project meetings, including the Pre-bid meeting, Pre-construction meeting and regular job-site meetings.

Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.

As a minimum, provide:

Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.

Separate dumpsters for each category of recyclable.

Recycling bins at worker lunch area.

Provide containers as required.

Provide adequate space for pick-up and delivery and convenience to subcontractors. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 017419



**SECTION 017700  
PROJECT  
CLOSEOUT**

**1.1 GENERAL**

**A. RELATED DOCUMENTS**

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

**B. SUMMARY**

1. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
  - a. Inspection procedures
  - b. Project record document submittal
  - c. Operating and maintenance manual submittal
  - d. Submittal of warranties
  - e. Final cleaning
  - f. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions - 2 through - 33.

**C. SUBSTANTIAL COMPLETION**

1. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
  - a. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
    - 1) If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
  - b. Advise Owner of pending insurance change-over requirements.
  - c. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
  - d. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
  - e. See the *Supplemental Conditions of the Contract for Construction* 3.11 for Documentation and As-Built Conditions, and the *Project Closeout Checklist: Contractor Requirements*. Submit maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.
  - f. Deliver tools, spare parts, extra stock, and similar items.
  - h. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
  - i. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

2. Inspection Procedures: On receipt of a request for inspection, the Consultant will either proceed with inspection or advise the Contractor of unfilled requirements. The Consultant will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
    - a. The Consultant will repeat inspection when requested and assured that the Work has been substantially completed.
    - b. Results of the completed inspection will form the basis of requirements for final inspection.
- D. FINAL ACCEPTANCE
1. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
    - a. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
    - b. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
    - c. Submit a certified copy of the Consultant's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Consultant.
    - e. Submit consent of surety to final payment.
    - f. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  2. Re-inspection Procedure: The Consultant will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Consultant.
    - a. Upon completion of re-inspection, the Consultant will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
    - b. If necessary, re-inspection will be repeated.
- E. RECORD DOCUMENT SUBMITTALS
1. **See also the *Supplemental Conditions of the Contract for Construction 3.11 for Documentation and As-Built Conditions, and the Project Closeout Checklist: Contractor Requirements.***
  2. General: Do not use record documents (red-line markups) for construction purposes; protect from deterioration and loss in a secure, fire-resistant location; provide access to record documents for the Consultant's reference during normal working hours.
  3. Record Drawings (Red-lined): Maintain two clean, undamaged sets of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the sets to show the red-line changes during the course of construction with actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the

corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

- a. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
  - b. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
  - c. Note related Change Order numbers where applicable.
  - d. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
4. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
- a. Upon completion of the Work, submit record Specifications to the Consultant for the Owner's records.
5. Record Product Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark up of record drawings and Specifications.
- a. Upon completion of mark-up, submit (3) complete sets of record Product Data to the Consultant for the Owner's records.
6. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Consultant and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area
7. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Consultant for the Owner's records.
8. Maintenance Manuals: Provide one (1) draft copy for review. Provide **one (1)** final paper copy and one electronic pdf file prior to final completion. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 3-inch, 3 ring vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include the following types of information; and others as specified in other Divisions:
- a. Emergency instructions
  - b. Spare parts list
  - c. Copies of warranties
  - d. Wiring diagrams

- e. Recommended "turn around" cycles
- f. Inspection procedures
- g. Shop Drawings and Product Data
- h. Fixture lamping schedule
- i. List of final color and material selections

## F. WARRANTIES AND BONDS

### 1. SUMMARY

- a. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
  - 1) Refer to the General Conditions and Supplemental Conditions for terms of the Contractor's special warranty of workmanship and materials.
  - 2) General closeout requirements are included in Section "Project Closeout."
  - 3) Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.
  - 4) Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- b. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- c. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

### 2. DEFINITIONS

- a. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- b. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

## G. WARRANTY REQUIREMENTS

- a. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- b. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- c. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is

responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.

- d. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
  - 1) Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- di. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

#### 4. SUBMITTALS

- a. Submit written warranties to the Consultant prior to the date certified for Substantial Completion. If the Consultant's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Consultant.
  - 1) When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Consultant within fifteen days of completion of that designated portion of the Work.
- b. Forms of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- c. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
  - 1) Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name or the product, and the name, address and telephone number of the installer.
  - 2) Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the Project title or name, and the name of the Contractor.
- d. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

## 1.2 EXECUTION

### A. CLOSEOUT PROCEDURES

1. Functional Demonstration: Demonstrate proper operation of all systems to Consultants and Owners representative prior to request for substantial completion. Coordinate schedule with Consultant.
2. Operating and Maintenance Instructions: Provide two (2) duplicate training sessions for each MSU trade group responsible for systems installed under this project. Coordinate schedule with Owner. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
  - a. Maintenance manuals
  - b. Record documents
  - c. Spare parts and materials
  - d. Tools
  - e. Lubricants
  - f. Fuels
  - g. Identification systems
  - h. Control sequences
  - i. Hazards
  - j. Cleaning
  - k. Warranties and bonds
    - 1) Maintenance agreements and similar continuing commitments

**END OF SECTION 017700**

**SECTION 017823  
OPERATION AND MAINTENANCE DATA**

**PART 1 - GENERAL**

**1.1 A.RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Operation manuals for systems, subsystems, and equipment.
  - 3. Product maintenance manuals.
  - 4. Systems and equipment maintenance manuals.

**1.3 CLOSEOUT SUBMITTALS**

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
  - 2. One paper copy and one electronic pdf. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will deliver copies to the Owner.
- C. Manual Submittal: Submit each manual in DRAFT in PDF format form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments. PROVIDE PAPER AND PDF OF FINAL APPROVED MANUALS

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

## PART 2 - PRODUCTS

### 2.1 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  1. Title page.
  2. Table of contents.
  3. Manual contents.
- C. Title Page: Include the following information:
  1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  9. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily



navigated file tree. Configure electronic manual to display bookmark panel on opening file.

- G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: These binders are sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and oversize sheets will need to be folded to 8x11.5.
    - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
  4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor is delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Precautions against improper use.
  9. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.

7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- CI. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- CII. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.3 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## 2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

- B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of operation and maintenance manuals.
- E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### PART 4 - MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. General: Incorporate as part of the O& M Manuals. Material and finishes to the Architect/Engineer for approval and distribution. Provide one section for architectural products, including applied materials and finishes, and a second section for products designed for moisture protection and products exposed to the water.
  - 1. Refer to individual specification sections for additional requirements on the care and maintenance of materials and finishes
- B. Architectural Products, Applied Materials and Finishes: Provide complete manufacturers data and instructions on the care and maintenance of architectural products, including applied materials and finishes.
- C. Manufacturers Data: Provide complete information on architectural products, including but not limited to the following items, as applicable:
  - 1. Manufacturer's catalog number
  - 2. Size
  - 3. Material composition
  - 4. Color texture reordering information for specially manufactured products
  - 5. Manufacturer and supplier/installers contact information
  - 6. Warranty terms
- D. Care and Maintenance Instruction: Provide complete information on the care and maintenance of architectural products, including the manufacturer's recommendations for the types of cleaning agents to be used and the methods of cleaning. In addition, provide information regarding cleaning agents and methods which could prove detrimental to the product. Include the manufacturer's recommended schedule for cleaning and maintenance.

- E. Manufacturer's Data: Provide complete manufacturer's data giving detailed information including, but not limited to the following, as applicable:
  - 1. Applicable standards
  - 2. Chemical composition
  - 3. Installation details
  - 4. Inspection procedures
  - 5. Maintenance information
  - 6. Repair procedures
  
- F. Schedule: Provide complete information in the materials and finishes manual on products specified in the following sections: (To be determined with Owner)
  
- G. Color Schedule: Provide complete information on MSU CPDC provided electronic spreadsheet form, to include manufacturer's name and number, location, item and surface of all painted, stained or treated material, surface or piece of equipment.

**END OF SECTION 017823**



**SECTION 017839  
PROJECT RECORD DOCUMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. See also General Conditions and Supplemental Conditions of the Contract for Construction.
- B. **See the *Supplemental Conditions of the Contract for Construction 3.11 for Documentation and As-Built Conditions, and the Project Closeout Checklist: Contractor Requirements***
- C. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- D. Related Requirements:
  - 1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 2. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

**1.2 CLOSEOUT SUBMITTALS**

- A. Record Drawings (Redline Markups): Comply with the following:
  - 1. Number of Copies: Submit copies of record Drawings as follows:
    - a. Draft Submittal:
      - 1) Submit PDF electronic files of scanned record prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and one set(s) of prints.
      - 3) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one annotated PDF electronic files and directories of each submittal.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Record data as soon as possible after obtaining it.
    - c. Record and check the markup before enclosing concealed installations.
  2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name and PPA Number.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

### 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.



4. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file

### 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.

### 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

**END OF SECTION 017839**

**SECTION 017900  
DEMONSTRATION AND TRAINING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**1. System Demonstration:**

- a. **General:**
  - i. The system demonstration is a functional test of systems to determine whether they are substantially complete and operating as specified. Systems are to be tested and confirmed to be operating properly by the contractor prior to the Demonstration.
  - ii. Where initial Demonstration Session uncovers substantial deficiencies that require more than one Demonstration Session, Contractor shall reimburse Owner for personnel costs associated with performing subsequent Sessions.
- b. **Systems to be Tested:**
  - i. All systems installed and/or provided under the project to have functional testing.
- c. **Attendance:**
  - i. The system demonstration is to be provided by trained representatives that are familiar with the systems, and can operate systems as required to test and verify proper function. The Engineer and Owner's representatives will be present to document performance and/or deficiencies. The General Contractor or others may attend if desired.
  - ii. Individual testing sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. MSU trades groups and systems typically involved in testing are:
    - (1) Electricians
    - (2) Heating Plant (Hydronic and steam heating systems, controls)
    - (3) Plumbers (Plumbing, gas-fired heating, process piping systems)
    - (4) Refrigeration (Refrigeration, chilled water, packaged cooling systems)
- d. **Schedule:**
  - i. Contractor to coordinate time requirements and dates with Owner and Engineer. Begin scheduling with sufficient time prior to desired Substantial Completion date to allow all parties to work into schedule, and for deficiencies to be completed prior to desired Substantial Completion date. Demonstration is to be provided prior to, and separate from, training.

**2. Training:**

- a. **General:**
  - i. The system training is intended to familiarize the Owner's operating and maintenance staff with all systems requiring maintenance. Training is to be provided after the systems are in place and operational, after issues noted during the Demonstration have been resolved, and before final acceptance.
- b. **Systems Requiring Training:**
  - i. All systems installed and/or provided under the project are to have training.
- c. **Attendance:**
  - i. Training is to be provided by trained representatives that are familiar with the system's operation and maintenance requirements. Individual training sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. MSU trades groups and systems typically requiring training are:
    - (1) Electricians

- (2) Heating Plant (Hydronic and steam heating systems, controls)
- (3) Plumbers (Plumbing, gas-fired heating, process piping systems)
- (4) Refrigeration (Refrigeration, chilled water, packaged cooling systems)
- d. Schedule:
  - i. Duplicate training sessions are to be provided for each training module, so that Owner's operating personnel can be split into two groups during training. Duplicate training sessions to be scheduled during different weeks. Length of training sessions will be determined by scope of training, and as coordinated with Owner after draft copy of training documents have been reviewed.

## 2.1 PRODUCTS

- 1. Not applicable

## 3.1 EXECUTION

- 1. Demonstration:

- a. Demonstration Program:

- i. Engineer to develop a demonstration program to verify the proper operation of all required systems. Submit program to Owner and Contractor at least two weeks prior to Demonstration.
- ii. Engineer to work with Contractor to generate methods to be used to verify sequences and modes of operation that cannot be verified directly.
- iii. Engineer to provide at least one copy of all submittals, contract drawings, specifications, and changes related to systems to be demonstrated. Documents to be made available during Demonstration.
- iv. Contractor to provide at least one copy of Operating and Maintenance Manuals to be used during demonstration, including specified sequences of operation for field-constructed systems, and operating sequences for all manufactured equipment.

- b. Demonstration Session:

- i. Verify that all systems are functional and ready to operate in all modes prior to demonstration.
- ii. Assemble all program materials required for demonstration.
- iii. Contractor to provide all equipment necessary for access to, and operation of, systems including tools, ladder, lighting, and diagnostic equipment.
- iv. Verify operation of individual components within systems.
- v. Verify controls of related components are coordinated.
- vi. Verify all operating sequences, operating modes, and safety controls.
- vii. Record all pressures, temperatures, and other relevant data available from installed devices.
- viii. Where digital control systems are available, set-up trend reports of relevant parameters which will confirm proper operation of systems installed, modified, or affected by changes made during this project. Provide copies of reports to Engineer and Owner for review. Review, analyze, and discuss results, and provide follow-up reports as required to confirm proper operation.

- 2. Training:

- a. Training Documentation:

- i. Contractor to submit draft copy of agenda and training documents to Owner for review at least two weeks prior to training date.
- ii. Provide a copy of the following items for each person that will be attending the

training sessions. Coordinate required number with the Owner.

- (1) Training agenda.
- (2) Summary of new systems and existing systems affected by this project.
- (3) Summary of work performed under this project.
- (4) Control system drawings and sequences of operation.
- (5) List of important maintenance and trouble-shooting operations for all systems.

iii. Provide minimum of 2 copies of following items:

- (1) Contract documents including all drawings, specifications, addendums, and change orders.

b. Training Sessions:

- i. Assemble at location to be determined by the Owner.
- ii. Distribute training documentation as indicated above.
- iii. Provide classroom style training if required for orientation, discussion of new systems and existing systems affected by this project, and other issues appropriate for a classroom format.
- iv. Visit site and review locations, and perform detailed review of operation and maintenance requirements for current systems.

**END OF SECTION 179000**

**SECTION 01 81 19**  
**INDOOR AIR QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. The intent of these Requirements are to:
  - 1. Minimize exposure of construction workers to air pollutants.
  - 2. Prevent air pollutants from collecting in building systems and on building materials.
  - 3. Prevent air pollutants caused by construction from migrating into occupied spaces.

**1.2 DEFINITIONS**

- A. For the purposes of these Requirements, "Air Pollutants" are defined as:
  - 1. Particulates
  - 2. Volatile Organic Compounds (VOCs)
  - 3. Formaldehyde
  - 4. Combustion emissions
  - 5. Airborne bacteria and micro-organisms
  - 6. Airborne inorganic compounds such as ozone (from electrical motors), metal fumes (from soldering and welding), and ammonia and chlorine (from cleaning products).

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. It is not the intent of this document to replace or supersede OSHA regulations as to safe construction workplace practices. It remains the responsibility of the Construction Manager and the individual sub-contractors to maintain safe building and site operations. Additional precautions may be necessary when hazardous materials are present.
- B. This plan will address construction IAQ by recommending procedures in five areas of concern:
  - 1. HVAC system protection
  - 2. Contaminant source control
  - 3. Pathway interruption
  - 4. Housekeeping
  - 5. Scheduling

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.1 CONTROL MEASURES - DURING CONSTRUCTION**

- A. The General Contractor and all applicable Subcontractors will be responsible for planning, coordinating, and implementing the following control measures.
  - 1. Source Control
    - a. Use low VOC products as indicated by the specifications to reduce potential problems.
  - 2. Pathway Interruption
    - a. During construction, isolate areas of work to prevent contamination of clean or occupied areas.
    - b. Weather permitting; ventilation using 100% outside air will be used to exhaust contaminated air directly to the outside during installation of VOC emitting materials.
  - 3. Housekeeping
    - a. Suppress and minimize dust with wetting agents or sweeping compounds. Acceptable methods include damp cloth, wet mop, or vacuum with particulate

- filters, or wet scrubber.
- b. Remove accumulations of water inside the building. Protect porous materials such as insulation and gypsum board from moisture.

**END OF SECTION 01 81 19**

**SECTION 024119  
SELECTIVE DEMOLITION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
- 2. 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 QUALITY ASSURANCE**

- 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 A10.6 and NFPA 241.

**1.5 PRE-INSTALLATION MEETINGS**

- A. Pre-demolition Conference: Conduct conference at Project site.

**1.6 CLOSEOUT SUBMITTALS**

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

**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.
  - 1. Before selective demolition, Owner will remove the following items:
    - a. Text books and other loose classroom resources.
    - b. Loose shelving units and storage cabinets.
    - c. Loose furniture (tables and chairs).
    - d. Loose equipment.

- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is included in the Contract Documents. Examine report to become aware of locations where hazardous materials are present. Do not proceed with selective demolition until all hazardous materials have been removed. Do not proceed with selective demo until all hazardous materials have been removed.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials
  - i. except under procedures specified elsewhere in the Contract Documents.

DI. Storage or sale of removed items or materials on-site is not permitted.

DII. Utility Service: Maintain existing utilities and the protection facilities indicated to remain in and protect them against damage during selective demolition operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- 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. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. 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 and email a written report to Architect and MSU Project Manager.

### 3.2

#### UTILITY SERVICES AND MECHANICAL/ ELECTRICAL SYSTEMS

- A. Existing Services/ Systems to Remain: Maintain services/ systems indicated to remain and protect them against damage.
- B. Comply with requirements for existing services/ systems interruptions specified in Section 011000 "Summary."
- C. 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. 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.

2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
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.
8. Ducts to be removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
9. Ducts to be abandoned in place: Cap or plug ducts with same or compatible ductwork material.

### 3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls".

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

### 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:

B. . 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.

C. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

D. Do not use cutting torches for selective demolition operations.

E. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

F. Dispose of demolished items and materials promptly.

G. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on campus as directed by Owner.
5. Protect items from damage during transport and storage.

H. Removed and Reinstalled Items:

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

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 Waste "Construction Management and Disposal".

B. Burning: Do not burn demolished materials.

### 3.6 CLEANING

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

**END OF SECTION 024119**

**SECTION 03 35 11  
CONCRETE FLOOR FINISHES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Surface treatments for concrete floors and slabs.

**1.2 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

**1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

**1.4 FIELD CONDITIONS**

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.

**PART 2 PRODUCTS**

**2.1 COATINGS**

- A. Concrete Stain: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
  - 1. Products:
  - 2. Earthpaint NanoTech
    - a. Substitutions: See 01 25 00 for Substitution Procedures
- B. High Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
  - 1. Composition: Acrylic polymer-based.
- C. Composition: Water-based, non-reactive.
  - 1. Composition: Acrylic polymer-based.
  - 2. VOC: 100 g/L or less.
  - 3. Products:
    - a. Earthpaint: NanoTech Concrete Sealer
    - b. Substitutions: See 01 25 00 for Substitution Procedures

**PART 3 EXECUTION**

**3.1 PREPARATION**

- A. Acid wash, blast or grind the concrete. Remove heavy grease With Earth Clean.

**3.2 EXAMINATION**

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

**3.3 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

**3.4 COATING APPLICATION**

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**3.5 CONCRETE POLISHING**

- A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.

HIGH PLAINS ARCHITECTS, P.C.  
22210

Barnard Room 8 Quantum Foundry Renovation  
Bozeman, Montana

**END OF SECTION 03 35 11**

**SECTION 05 40 00**  
**COLD-FORMED METAL FRAMING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Formed steel stud interior wall framing.
- B. Formed steel joist ceiling framing.

**1.2 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
- B. Section 07 92 00 - Joint Sealants.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

**1.3 REFERENCE STANDARDS**

- A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data 2017
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing 2015, with Errata (2020).
- C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.
- D. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015
- E. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- G. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018.
- H. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

**1.4 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Metal Framing:
  - 1. CEMCO; \_\_\_\_\_: [www.cemcosteel.com/#sle](http://www.cemcosteel.com/#sle).
  - 2. ClarkDietrich; \_\_\_\_\_: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - 3. Jaimes Industries; \_\_\_\_\_: [www.jaimesind.com/#sle](http://www.jaimesind.com/#sle).
  - 4. Steel Construction Systems; \_\_\_\_\_: [www.steelconsystems.com/#sle](http://www.steelconsystems.com/#sle).
  - 5. The Steel Network, Inc; \_\_\_\_\_: [www.SteelNetwork.com/#sle](http://www.SteelNetwork.com/#sle).
  - 6. Substitutions: See Section 01 25 00 for Substitution Procedures.
- B. Framing Connectors and Accessories:
  - 1. Same manufacturer as metal framing.

**2.2 FRAMING SYSTEM**

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

**2.3 FRAMING MATERIALS**

- A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
  - 1. Gage and Depth: 20 ga., 3 5/8 in.
  - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.

- B. Ceiling Joists: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
- C. Framing Connectors: Factory-made, formed steel sheet.
  - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch (3.42 mm), and factory punched holes and slots.
  - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.

#### **2.4 FASTENERS**

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

#### **2.5 WALL SHEATHING**

- A. Gypsum Board Wall Sheathing: See Section 09 21 16.

#### **2.6 ACCESSORIES**

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION OF STUDS**

- A. Install wall studs plumb and level
- B. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- C. Align floor and ceiling tracks; locate to wall layout. Coordinate installation of sealant with floor and ceiling tracks.
- D. Place studs at 16 inches (400 mm) on center; not more than 2 inches (50 mm) from abutting walls and at each side of openings. Connect studs to tracks using fastener method.
- E. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
- F. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- G. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

#### **3.2 INSTALLATION OF CEILING JOISTS AND PURLINS**

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Locate joist end bearing directly over load bearing studs or provide load distributing member to top of stud track.

#### **3.3 TOLERANCES**

- A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft (3.2 mm in 3000mm), in accordance with ASTM C1007.
- B. Studs - Maximum Variation from True Position: 1/8 inch (3.2 mm) in accordance with ASTM C1007.
- C. Stud Spacing: 1/8 inch (3.2 mm) from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

HIGH PLAINS ARCHITECTS, P.C.  
22210

Barnard Room 8 Quantum Foundry Renovation  
Bozeman, Montana

**END OF SECTION 05 40 00**





**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Shop fabricated aluminum items.
- B. Aluminum shelves, rods, connections, hangers, aluminum or steel plate shelving on suspended unistrut subframe or owner approved substitution.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 51 00 - Acoustical Ceilings: Structural Suspension System
- B. Section 12 22 16 - Drapery Track and Accessories: Laser Curtain Track

**1.3 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- D. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

**1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements Submittals, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

**PART 2 PRODUCTS**

**2.1 MATERIALS - ALUMINUM**

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Bolts, Nuts, and Washers: Stainless steel.

**2.2 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

**2.3 FABRICATED ITEMS**

- A. Suspended Aluminum Shelves: Steel tubing, aluminum plate, rods, angles, as detailed;
  - 1. Frame: Hollow Structural Steel, angles, and plates in shapes, dimensions and configuration indicated on the drawings.
  - 2. Tie-rods: End-threaded rods in shapes, dimensions and configurations indicated on the drawings.
  - 3. Brackets: Plate steel in dimension and configuration indicated in the drawings.

**2.4 FINISHES - ALUMINUM**

- A. Interior Aluminum Surfaces: Class I natural anodized.

- B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

## **2.5 FABRICATION AND TOLERANCES**

- A. Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
- B. Fabrication Tolerances
  - 1. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
  - 2. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
  - 3. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
  - 4. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
  - 5. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.2 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.

### **3.3 INSTALLATION**

- A. All shelving to coordinate with suspended ceiling structure, laser curtain track, optic tables and glove boxes.
- B. Install items plumb and level (unless noted otherwise), accurately fitted, free from distortion or defects.
- C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed .

**END OF SECTION 05 50 00**

**SECTION 07 92 00**  
**JOINT SEALANTS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- C. Section 12 35 53 Casework: Sealant between countertops and plumbing fixtures and at junctions with other materials and changes in plane.

**1.3 REFERENCE STANDARDS**

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- B. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

**1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01 61 16.

**PART 2 PRODUCTS**

**2.1 JOINT SEALANT APPLICATIONS**

- A. Scope:
  - 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints indicated below.
  - 2. Do not seal the following types of joints.
    - a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - c. Joints where installation of sealant is specified in another section.
    - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use non-sag acrylic emulsion latex sealant, unless otherwise indicated.
  - 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
  - 2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.

3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
  4. Narrow Control Joints in Interior Concrete Slabs: Self-leveling sealant.
- C. Interior Wet Areas: fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

## **2.2 JOINT SEALANTS - GENERAL**

- A. Sealants and Primers: Provide products having equal or lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

## **2.3 NONSAG JOINT SEALANTS**

1. Color: Clear.
2. Movement Capability: Plus and minus 35 percent, minimum.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Color: Standard colors matching finished surfaces, Type OP (opaque).

## **2.4 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
  2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

### **3.2 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

### **3.3 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing

period, unless manufacturer's approval is obtained and instructions are followed.

- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

**3.4 POST-OCCUPANCY**

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

**END OF SECTION 07 92 00**



**SECTION 08 12 13  
HOLLOW METAL FRAMES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 14 16 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.
- B. Section 08 71 00 - Door Hardware: Hardware.
- C. Section 09 91 23 - Interior Painting: Field painting.

**1.3 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

**1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements Submittals for Submittal Procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Hollow Metal Frames with Integral Casings:
  - 1. Ceco Door, an Assa Abloy Group company; \_\_\_\_\_: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
  - 2. Curries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).

3. Steelcraft, an Allegion brand; \_\_\_\_: [www.allegion.com/#sle](http://www.allegion.com/#sle).
4. Substitutions: See Section 01 25 00 Substitution Procedures.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Refer to Door and Frame Schedule on the drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Door Frame Type: Provide hollow metal door frame.
  1. Interior Doors: Use frames with applied casings.
- C. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- D. Accessibility: Comply with ICC A117.1 and ADA Standards.
- E. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- F. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

## **2.3 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS**

- A. Type HM , Interior Door Frames, Non-Fire Rated: Knock-down type.
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 1 - Standard-duty.
    - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Frame Metal Thickness: 18 gage, 0.042 inch (1.0 mm), minimum.
  2. Frame Finish: Factory primed and field finished.

## **2.4 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
  1. Color: To be selected by Architect from manufacturer's standard range.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

### **3.2 INSTALLATION**

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.

**END OF SECTION 08 12 13**



**SECTION 08 14 16**  
**FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Flush wood door to new closet; nonrated

**1.2 RELATED REQUIREMENTS**

- A. Section 08 12 13 - Hollow Metal Frames.
- B. Section 09 93 00 - Staining and Transparent Finishing: Field finishing of doors.

**1.3 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2018).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

**1.4 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Package, deliver and store door in accordance with specified quality standard.
- B. Accept door on site in manufacturer's packaging. Inspect for damage.
- C. Protect door with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

**1.7 WARRANTY**

- A. See Section 01 77 00 Project Closeout, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
- B. High Pressure Decorative Laminate (HPDL) Faced Doors:
  - 1. VT Industries, Inc; \_\_\_\_: [www.vtindustries.com/#sle](http://www.vtindustries.com/#sle).
  - 2. Substitutions: See Section 01 25 00 for Substitution Procedures.

**2.2 DOORS**

- A. Doors: Refer to drawings for locations and additional requirements.
  - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
  - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
  - 3. Wood doors shall contain no added urea formaldehyde (NAUF).

**2.3 DOOR FACINGS**

- A. Veneer Facing for Transparent Finish: match existing doors.
  - 1. Vertical Edges: Same species as face veneer.

**2.4 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Edge Construction: AWS Type "D" - Solid wood edgeband, veneer face edge shows.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

## **2.5 ACCESSORIES**

- A. Hollow Metal Door Frames: As specified in Section 08 12 13.
- B. Door Hardware: As specified in Section 08 71 00.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.2 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.

### **3.3 TOLERANCES**

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

### **3.4 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**END OF SECTION 08 14 16**

**SECTION 08 43 13**  
**ALUMINUM-FRAMED STOREFRONTS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Non-thermal Interior Aluminum-framed Storefront

**1.2 RELATED REQUIREMENTS**

- A. Section 05 40 00 Cold-Formed Metal Framing
- B. Section 08 80 00 - Glazing: Glass and glazing accessories.

**1.3 REFERENCE STANDARDS**

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with installation of other components that comprise the new hallway enclosure.

**1.5 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.
- B. Product Data: Include construction details, material descriptions, and fabrication methods, dimensions of individual components and profiles, finishes and installation instructions.
- C. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

**1.8 WARRANTY**

- A. See Section 01 74 00 for additional Warranty Requirements.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
  - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided, however, that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

**PART 2 PRODUCTS**

**2.1 BASIS OF DESIGN -- FRAMING FOR NON-THERMAL INTERIOR GLAZING**

- A. Center-Set Style:
  - 1. Basis of Design: Oldcastle, FG-2000
  - 2. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep (44 mm wide by 114 mm deep).

## **2.2 MANUFACTURERS**

- A. Aluminum-Framed Storefront:
  - 1. Oldcastle BuildingEnvelope: [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
  - 2. Substitutions: See Section 01 25 00 for Substitution Procedures.

## **2.3 COMPONENTS**

- A. Aluminum Framing Members: Tubular aluminum sections.
  - 1. Glazing Stops: Flush.
- B. Glazing: Able to receive 1/4 inch nominal glazing-unit as specified in Section 08 80 00.

## **2.4 MATERIALS**

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Aluminum, non magnetic stainless steel or other materials to be non-corrosive and compatible with anchors and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron.
- E. Glazing Accessories: As specified in Section 08 80 00.

## **2.5 FINISHES**

- A. Class II Color Anodized Finish: AAMA 611 AA-M12C22A32 Integrally colored anodic coating not less than 0.4 mils (0.01 mm) thick.
- B. Color: : Clear Anodized Aluminum.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings are ready to receive work of this section..

### **3.2 INSTALLATION**

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions.
- B. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

**END OF SECTION 08 43 13**

**SECTION 08 71 00  
DOOR HARDWARE**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Hardware for new closet door.

**1.2 RELATED REQUIREMENTS**

- A. Section 06 20 00 - Finish Carpentry: Wood door frames.
- B. Section 08 14 16 - Flush Wood Doors.

**1.3 REFERENCE STANDARDS**

- A. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

**1.4 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.

**1.5 WARRANTY**

- A. See Section 01 74 00, for additional warranty requirements.
- B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
  - 1. Locksets and Cylinders: Three years, minimum.
  - 2. Other Hardware: Two years, minimum.

**PART 2 PRODUCTS**

**2.1 DESIGN AND PERFORMANCE CRITERIA**

- A. Reuse existing hardware on relocated double door .
- B. Provide passage hardware for new closet door.
- C. Provide door hardware products that comply with the following requirements:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. Accessibility: ADA Standards and ICC A117.1.

**2.2 PASSAGE LEVER**

- A. Manufacturers:
  - 1. Schlage, an Allegion brand; \_\_\_\_\_: [www.allegion.com/us/#sle](http://www.allegion.com/us/#sle).
  - 2. Match existing door style and manufacturer.

**2.3 FINISHES**

- A. Satin Chrome

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

**3.2 ADJUSTING**

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

**3.3 CLEANING**

**3.4 PROTECTION**

- A. Protect finished Work under provisions of Section 01 77 00 for Project Closeout.
- B. Do not permit adjacent work to damage hardware or finish.

**END OF SECTION 08 71 00**

**SECTION 08 80 00  
GLAZING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Glazing units to be installed in new corridor wall.
- B. Glazing compounds and accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 05 40 00 - Cold-Formed Metal Framing
- B. Section 08 43 13 - Aluminum-Framed Storefronts:

**1.3 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- C. GANA (GM) - GANA Glazing Manual; 2008.
- D. GANA (SM) - GANA Sealant Manual; 2008.

**1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit one samples 3 by 3 inch (\_\_\_ by \_\_\_ mm) in size, minimum, of glass units.
- E. Samples: Submit 6 inch (\_\_\_ mm) long bead of glazing sealant, color as selected.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

**1.6 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

**PART 2 PRODUCTS**

**2.1 GLASS MATERIALS**

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
  - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.

**2.2 GLAZING UNITS**

- A. Type G-1 Monolithic Interior Vision Glazing:
  - 1. Applications:
    - a. Borrowed lites.
  - 2. Glass Type: Annealed float glass.
  - 3. Tint: Clear.
  - 4. Thickness: 1/4 inch (6.4 mm), nominal.
- B. Type G-3 - Obscure Glazing.
  - 1. Applications: Ceiling locations as indicated on drawings.
  - 2. Finish: F1 - Patterned one side; ASTM C1036.
  - 3. Style: acid-etched.

4. Tint: Clear.
5. Glass Type: Laminated annealed.
6. Thickness: 1/4 inch (6.4 mm), nominal.

### **2.3 GLAZING COMPOUNDS**

- A. Type GC-2 - Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

### **2.4 ACCESSORIES**

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

## **PART 3 EXECUTION**

### **3.1 VERIFICATION OF CONDITIONS**

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

### **3.2 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.3 INSTALLATION, GENERAL**

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

### **3.4 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)**

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Carefully trim protruding tape with knife.

### **3.5 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.



- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

**END OF SECTION 08 80 00**



**SECTION 09 21 16**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum board. (GB)
- E. Acoustic gypsum board
- F. Joint treatment and accessories.
- G. Textured finish system.

**1.2 RELATED REQUIREMENTS**

- A. Section 05 40 00 - Cold-Formed Metal Framing: metal stud framing.
- B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

**1.3 REFERENCE STANDARDS**

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018a.
- E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- J. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- K. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site prior to framing of interior partitions.

**1.5 SUBMITTALS**

- A. See Section 01 30 00 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, illustrating finish color and texture.

**PART 2 PRODUCTS**

**2.1 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
  - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

## 2.2 NON STRUCTURAL METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. ClarkDietrich Building Systems; \_\_\_\_: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - 2. Armstrong World Industries, Inc.: [www.armstrongbuildingsolutions.com](http://www.armstrongbuildingsolutions.com)
  - 3. Substitutions: See Seciton 01 25 00 for Substitution Procedures.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
  - 1. Ceiling Channels: C-shaped.
- C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

## 2.3 GYPSUM BOARD MATERIALS

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Thickness:
    - a. Vertical Surfaces: 5/8 inch (16 mm).
    - b. Ceilings: 5/8 inch (16 mm).
- B. Acoustical Gypsum Board: Two layers of heavy paper faced, density gypsum board separated by a viscoelastic polymer layer and capable of achieving STC rating of 50 or more in typical stud wall assemblies as calculated in accordance with ASTM E413 and when tested in accordance with ASTM E90.
  - 1. Thickness: 5/8 inch (16 mm).
  - 2. Long Edges: Tapered.
  - 3. Products:
    - a. CertainTeed Corporation; SilentFX Quick Cut Type X Gypsum Board.
    - b. National Gypsum Company; Gold Bond SoundBreak XP Gypsum Board: [www.nationalgypsum.com/#sle](http://www.nationalgypsum.com/#sle).
    - c. PABCO Gypsum; QuietRock 530: [www.QuietRock.com](http://www.QuietRock.com).
    - d. Substitutions: See Section 01 25 00 for Substitution Procedures.

## 2.4 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch (\_\_\_\_ mm).
  - 1. Recycled Content: Minimum 40 percent post-consumer recycled content.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
  - 1. Corner Beads: Low profile, for 90 degree outside corners.
  - 2. Splayed Corner Beads: 45 degree outside corner.
  - 3. L-Trim: Sized to fit 5/8 inch (\_\_\_\_ mm) thick gypsum wallboard.
- C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- D. Textured Finish Materials: Latex-based compound; plain.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion resistant.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

#### **3.2 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions., including:
  - 1. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant in accordance with ASTM E-90. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with additional manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

#### **3.3 FRAMING INSTALLATION**

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Ceilings and Soffits: Space framing and furring members at 16 inches on center (at 400 mm on center).
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
  - 1. Extend partition framing to structure, ceiling or partial height as indicated on the drawings.

#### **3.4 BOARD INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

#### **3.5 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Corner Beads: Install at external corners, using longest practical lengths.

#### **3.6 JOINT TREATMENT**

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 3: Walls to receive textured wall finish.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

#### **3.7 TEXTURE FINISH**

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.
- B. Texture Required: EXTREMELY light texture. Architect's approval of sample required prior to proceeding with work.

#### **3.8 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

### **END OF SECTION 09 21 16**

**SECTION 09 51 00**  
**ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Acoustical ceiling panels.
- B. Installation Accessories, wire hangers, main runners, cross tees and wall angle moldings
- C. Perimeter Trim

**1.2 RELATED REQUIREMENTS**

- A. Divisions 23 - HVAC Air Distribution
- B. Division 26 - Electrical
- C. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.

**1.3 REFERENCE STANDARD**

- A. ASTM A1008 Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- B. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
- C. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- D. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- F. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- G. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2019.
- J. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- K. ISO 14644-1 - Cleanrooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness by Particle Concentration; 2015.
- L. NFPA 70 National Electrical Code
- M. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- N. International Code Council-Evaluation Services Report - Seismic Engineer Report  
1. ESR 1308 - Armstrong Suspension Systems
- O. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report  
1. 0244 - Armstrong Single Span Suspension System

**1.4 SYSTEM DESCRIPTION**

- A. Structural Suspension Ceiling System, with 48 inches by 48 inches hanging points, shall be capable and intended to directly support cable trays, utilities, light fixtures, HVAC registers and other accessories as indicated in area of work.
- B. Coordinate installation with existing duct work, fire protection, lighting, and services. Coordinate wall attachment with electrical transformer relocation on adjacent wall.
- C. Do not install acoustical units until after interior wet work is dry.

### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for Submittal Procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples 6 inch by 6 inch (\_\_\_\_by\_\_\_\_ mm) in size illustrating material and finish of acoustical units.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Manufacturer's Qualification Statement.

### 1.6 SUSTAINABLE MATERIALS

- A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
- B. Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard
- C. Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
- D. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1
- E. Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred
- F. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.

### 1.7 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and structural grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify structural ceiling components with appropriate markings of applicable testing and inspecting organization.
  - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.
  - 2. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory Acoustic Tiles/Panels:
- C. Acoustical Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
- D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers

### 1.8 DELIVERY, STORAGE AND HANDLING

- A. A. Deliver structural ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. B. Before installing structural ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

**1.9 1.10 WARRANTY**

- A. A. Suspension: Submit a written warranty executed by the manufacturer, agreeing to repair or replace suspension system that fails within the warranty period. See Armstrong website for fully warranty information. Failures include, but are not limited to the following:

- 1. Grid System: Rusting and manufacturer's defects

**1.10 B. WARRANTY PERIOD**

- A. Grid: Ten years from date of substantial completion
- B. System Warranty of 30 years when used with Armstrong Ceiling Panels (Single Source Solution)
- C. The Warranty 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 Contractor under the requirements of the Contract Documents.

**1.11 PERFORMANCE**

- A. A. Structural:
  - 1. Capable of supporting a uniform load up to 56 lbs. / ft<sup>2</sup>
  - 2. Capable of a maximum static point load of 900 lbs.
  - 3. Capable of a maximum static point load of 900 lbs. with heavy duty connector in line with turnbuckle connection to building structure.
  - 4. Capable of supporting a mid-span point load of 320 lbs. with L/360 deflection (4' member span)
  - 5. Turnbuckle connection shall be capable of a maximum point load connection to building structure of 900 lbs.
  - 6. Contact local engineer for job-specific load and/or seismic requirements.
- B. MAINTENANCE
  - 1. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
  - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Suspension Systems:
- B. Basis of Design: Armstrong World Industries, Inc. DynaMax Structural Aluminum Grid System
- C. Ceiling Panels
  - 1. Basis of Design: Armstrong World Industries, Inc. Armstrong World Industries, Inc; [\_\_\_\_]: [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).
    - a. AirAssure Ceiling Panels for Clean Room performance and compatible with suspension system.
    - b. #DMPHDC Hold-down clip

**2.2 METAL SUSPENSION SYSTEMS**



- A. **Components: Aluminum extrusions factory produced. Special bosses are designed to connect AXTBC T-bar connector clip and splice plate; to provide positive mechanical lock with no visible fasteners. Factory finished matching approved samples**
1. Structural Classification: ASTM C 635 Heavy Duty
  2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
  3. Sustainability: Environmental Product Declaration (EPD), Health Product Declaration (HPD)
  4. Acceptable Product: DynaMax Main Beam #DM4301 144" x 2" x 2-3/8" manufactured by Armstrong World Industries
  5. Acceptable Product: DynaMax Cross Tee #DM4320 24" x 2" x 2-3/8" as manufactured by Armstrong World Industries
  6. Acceptable Product: DynaMax Cross Tee #DM4340 48" x 2" x 2-3/8" as manufactured by Armstrong World Industries
  7. Acceptable Product: DynaMax I Bracket #DMIB as manufactured by Armstrong World Industries
  8. Acceptable Product: DynaMax L Bracket #DMLB as manufactured by Armstrong World Industries
  9. Acceptable Product: DynaMax T Bracket #DMTB as manufactured by Armstrong World Industries
  10. Acceptable Product: DynaMax X Bracket #DMXB as manufactured by Armstrong World Industries
  11. Acceptable Product: DynaMax Hold Down Clip #DMHDC as manufactured by Armstrong World Industries
  12. Acceptable Product: DynaMax Hardware Kit #DMHWK as manufactured by Armstrong World Industries
  13. Acceptable Product: DynaMax Bottom Splice Plate #DMBSP as manufactured by Armstrong World Industries
  14. Acceptable Product: AXTBC - T-Bar Connector Clip manufactured by Armstrong World Industries
- B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least three design load, but not less than 12 gauge.
- C. Edge Moldings and Trim:
1. DynaMax Structural Aluminum Data Center Wall Molding #DM4800 144" x 2-1/8" x 2 x 1/2" manufactured by Armstrong World Industries, Inc.
- D. Structural Ceiling grid shall be installed with a FIXED or FLOATING condition option on a 2'x2' OR 2'x4' grid supported with spacing of 4'x4' connection to structure above
- E. Accessories: 3/8" threaded rod from structure.
1. Carries the system load with 3/8" threaded rod from structure.
- F. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
1. Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- G. DynaMax Lay in Ceiling Panels:
1. All panels should be factory cut to fit the DynaMax structural ceiling grid openings without field modifications to grid or panels.
    - a. Square Lay-In Nominal 2' x 2'
    - b. Clean Room or Ultima AirAssure 23 - 1/4" x 23 - 1/4" x 3/4" #1599
- H. MetalWorks Lay in Panels for DynaMax Structural Grid:

1. All panels should be factory cut to fit the DynaMax structural ceiling grid openings without field modifications to grid or panels.
  - a. Square Lay-In Nominal 2' x 4' and 4'x4' module sizes
  - b. Composition: 064 Aluminum
    - 1) MetalWorks Lay-in for Dynamax 23" x 47" M1 Unperforated 6345W24L48M1WHA
    - 2) Color Whitelume
2. Substitutions: See Section 01 60 00 - Product Requirements.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

#### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
  1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work

#### **3.3 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.

#### **3.4 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

#### **3.5 ADJUSTING AND CLEANING**

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

- C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant will provide assistance to facilitate the recycle of the ceiling.

**END OF SECTION 09 51 00**



**SECTION 09 65 13  
RESILIENT BASE**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Resilient wall base and accessories for Room 008
- B. Substrate preparation

**1.2 RELATION REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board substrate.

**1.3 REFERENCES**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- B. ASTM F710 - Standard Practice for Preparing Concrete to Receive Resilient Flooring
- C. ASTM F1861 - Standard Specification for Resilient Wall Base

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical data sheet, care & maintenance document, submittal and/or warranty for each material and accessory proposed for use.

**1.5 QUALITY ASSURANCE**

- A. Provide resilient flooring materials manufactured in the United States of America by a firm with a minimum of 10 years' experience with resilient flooring materials of type equivalent to those specified.
- B. Installer must be professional, licensed, insured and acceptable to manufacturer of resilient flooring materials.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.
- B. Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

**1.7 PROJECT CONDITIONS**

- A. Maintain temperature and humidity at service levels or the ambient temperature must remain steady ( $\pm 10^{\circ}$  F) and be between  $65^{\circ}$  F and  $85^{\circ}$  F for at least 48-hours prior to, during and after installation. The ambient relative humidity is recommended to be between 40% and 65% RH; avoid dew point conditions.

**1.8 WARRANTY**

- A. Provide manufacturer's standard limited commercial warranty to cover manufacturing defects.

**PART 2 PRODUCTS**

**2.1 RESILIENT WALL BASE**

- A. Rubber Base type RB:
  - 1. Product:
    - a. Pinnacle rubber wall base as manufactured by Roppe Corporation ([www.roppe.com](http://www.roppe.com)).
    - b. Substitutions: 01 25 00 - Substitution Procedures
  - 2. Material, ASTM F1861: Type TS - rubber, vulcanized thermoset; Group 1 - solid; Style B - Cove
  - 3. Height: 4 inch
  - 4. Thickness: 1/8-inch
  - 5. Color:
    - a. Match color of existing base.

6. Surface Burning, ASTM E84: Class B
7. Substrate Preparation: Per ASTM F710 and Manufacturer's recommended installation procedures.
8. Adhesive: Manufacturer's recommended adhesives for applicable substrates.
  - a. Material: FloorScore-certified low VOC product as verified by CDPH SM. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Inspect all substrates to ensure they are clean, smooth, permanently dry, flat, and structurally sound.

**3.2 PREPARATION**

- A. Ensure substrate meets the requirements of ASTM F710, and manufacturer's technical data sheets. Substrates must be free of visible water or moisture, dust, sealers, paint, sweeping compounds, curing compounds, residual adhesives and adhesive removers, concrete hardeners or densifiers, solvents, wax, oil, grease, asphalt, visible alkaline salts or excessive efflorescence, mold, mildew and any other extraneous coating, film, material or foreign matter.

**3.3 INSTALLATION**

- A. Follow manufacturer's installation instructions and technical data sheet.

**3.4 CLEANING AND MAINTENANCE**

- A. Clean up installation area and sweep, dust or wipe material to remove any dirt, dust or debris.
- B. Conduct initial maintenance per the manufacturer's care and maintenance instructions.

**END OF SECTION 09 65 13**

**SECTION 09 67 00**  
**FLUID-APPLIED FLOORING (ALTERNATE 1)**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Fluid-applied flooring.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 81 19 Indoor Air Quality Requirements

**1.3 REFERENCE STANDARDS**

- A. ANSI/ESD STM7.1 - The Protection of Electrostatic Discharge Susceptible Items Flooring Systems Resistive Characterization; 2021.
- B. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

**1.4 SUBMITTALS**

- A. See Section 01 30 30 for Submittal Procedures.
- B. Product Data: Provide data on specified products, describing physical and performance and performance characteristics; sizes, patterns and colors available.
- C. Samples: Submit a 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Applicator Qualifications: The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
- C. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
- D. System shall be in compliance with the Indoor Air Quality requirements of California section 01350 as verified by a qualified independent testing laboratory.
- E. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.
- B. The Applicator shall be provided with a storage area for all components. The area shall be between 60 F and 90 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
- C. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by the Engineer or other personnel.

**1.7 WASTE DISPOSAL**

- A. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

## 1.8 FIELD CONDITIONS

### A. Site Requirements

1. Work area is required to be tented and with direct ventilation to outside. Air quality to be strictly monitored during process and curing.
2. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
3. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
4. The Applicator shall ensure that adequate ventilation is available for the work area.
5. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

### B. Safety Requirements

1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. The Owner shall be responsible for the removal of foodstuffs from the work area.
4. Non-related personnel in the work area shall be kept to a minimum.

## 1.9 WARRANTY

- A. Material shipped to be free from material defects and will perform substantially to published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.

## PART 2 PRODUCTS

### 2.1 FLOORING

#### A. Epoxy-Based seamless flooring system

1. System Materials:
  - a. Primer: Dur-A-Flex, Inc, Dur-A-Glaze #4 WB resin and hardener.
  - b. Base Coat: Dur-A-Flex, Inc, Dur-A-Gard resin and hardener.
  - c. Topcoat: Dur-A-Flex, Inc. Armor Top resin, hardener and pigment.
2. Patch Materials
  - a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Dur-A-Glaze #4 Cove Rez.
  - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Dur-A-Crete.

### 2.2 MANUFACTURER

- A. Basis of Design: Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802
- B. Manufacturer of Approved System shall be single source and made in the USA.

### 2.3 PERFORMANCE REQUIREMENT

- A. Minimal maintenance
- B. Maximum robustness: the flooring should be very robust to castors from chairs and equipment carts.
- C. Chemical resistance: resistant to chemical spills. Most commonly used chemicals include organic solvents such as acetone, DHF, toluene, etc.

### 2.4 PRODUCT REQUIREMENTS

- A. Primerj: Dur-A-Glaze #4 WB
  1. Percent Solids 56 %
  2. VOC 2 g/L
  3. Bond Strength to Concrete ASTM D 4541 fails, 550 psi, substrates fails
  4. Hardness, ASTM D 3363 3H



5. Elongation, ASTM D 2370 9%
6. Flexibility (1/4: Cylindrical mandrel), ASTM D 1737 Pass
7. Impact Resistance, MIL D-2794 >160
8. Abrasion Resistance ASTM D 4060,
9. CS 17 wheel, 1100 %,000 g Load
- B. Base Coat Dur-A-Gard
  1. Percent Solids 100 %
  2. VOC 3.45 g/L
  3. Compressive Strength, ASTM D 695, 16,000psi
  4. Tensile Strength, ASTM D 638, 3800 psi
  5. Flexural Strength, ASTM D 790 , 4,000 psi
  6. Abrasion Resistance, ASTM D 4060 C-10 Wheel, 1,000 gm load, 1,000 cycles, 35 mg loss
  7. Flame Spread/NFPA-101, ASTM E 84 Class A
  8. Flammability, ASTM D 635 Self Extinguishing
  9. Impact Resistance MIL D-3134 0.025 inch Max
  10. Water Absorption. MIL D-3134 0.04 %
  11. Potlife @ 70 F 20-25 minutes
- C. Topcoat Armor Top
  1. Percent Solids 95 %
  2. VOC 0 g/L
  3. Tensile Strength, ASTM D 2370 7,000 psi
  4. Adhesion, ASTM 4541 Substrate Failure
  5. Hardness, ASTM D 3363 4H
  6. 60° Gloss ASTM D 523 70
  7. Abrasion Resistance, ASTM D4060, CS 17 wheel (1,000 g load) 1,000 cycles
    - a. Gloss 4, Satin 8 mg loss with grit
    - b. Gloss 10 Satin 12 mg loss without grit
  8. Pot Life, 70 F, 50% RH, 2 hours
  9. Full Chemical Resistance 7 days

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
- B. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

#### **3.2 PREPARATION**

- A. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
- B. Moisture Testing: Perform tests recommended by manufacturer and as follows.
  1. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
  2. If the relative humidity exceeds 75% then a primer moisture mitigation system must be installed prior to resinous flooring installation.

- C. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
1. Mechanical surface preparation
    - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 2-3 as described by the International Concrete Repair Institute.
    - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
    - c. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
  2. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

### 3.3 APPLICATION

#### A. General

1. The system shall be applied in four distinct steps as listed below:
  - a. Substrate preparation
  - b. Priming
  - c. Base coat application.
  - d. Topcoat application
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

#### B. Primer

1. The primer shall be Dur-A-Glaze #4 WB that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
2. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200-250 sf/gal to yield a dry film thickness of 4 mils.

#### C. Base Coat

1. The base coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer.
2. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
3. The base coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 100 sf/gal to yield a dry film thickness of 16 mils.

#### D. Topcoat

1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.

2. The topcoat shall be comprised of a liquid resin, hardener and pigment that is mixed per the manufacturer's instructions.
3. The finish floor will have a nominal thickness of 23 mils.

**3.4 FIELD QUALITY CONTROL**

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
  - a. Temperature
    - 1) Air, substrate temperatures and, if applicable, dew point.
  - b. Coverage Rates
    - 1) Rates for all layers shall be monitored by checking quantity of material used against the area covered.

**3.5 CLEANING AND PROTECTION**

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

**END OF SECTION 09 67 00**



**SECTION 09 91 23**  
**INTERIOR PAINTING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Gypsum board.
  - 2. Exposed ductwork, electrical conduit, piping and pipe insulation including exposed fire sprinkler lines.
- B. Do not paint any existing wood building elements that maintain the original varnished finish. Such elements include but are not limited to: doors, relites, door and relite casing, railings, base, and casing. Protect all such existing finishes during painting.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 08 12 13 - Hollow Metal Frames: Interior hollow metal frames
- C. Section 09 21 16 - Gypsum Board Assemblies.

**1.3 REFERENCE STANDARDS**

- A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

**1.4 SUBMITTALS**

- A. See Section 01 25 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
  - 4. Indicate VOC content per Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- C. Samples: Submit 2 paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective coverings for storage and identified with labels describing contents.
  - 1. Paint: 1 gal. of each material and color applied.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

**1.7 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 foot-candles measured mid-height at substrate surface.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  - 1. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 25 00 - Substitution Procedures

### **2.2 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Materials Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and applications as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.
- D. Colors: To be selected from manufacturer's full range of available colors.
  - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

### **3.3 APPLICATION**

- A. Apply products in accordance with 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 equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- 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. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### **3.4 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### **3.5 PROTECTION**

- A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. 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.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### **3.6 INTERIOR PAINT SYSTEMS SCHEDULE**

- A. Gypsum Board Substrates:
  - 1. Latex System:
    - a. Prime Coat: Primer, latex, interior:
      - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.0 mils dry.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, eggshell:
      - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
    - d. Topcoat: Latex, interior, semi-gloss:
      - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- B. Concrete walls
  - 1. Latex System:
    - a. Prime Coat: Primer, latex, interior:

- 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.0 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, eggshell:
  - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- d. Topcoat: Latex, interior, semi-gloss:
  - 1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

**3.7 COLOR SCHEDULE**

PAIN #	COLOR/SHEEN	APPLICATION
1	SW# 6385 "Dover White" eggshell sheen	GB ceilings and walls
1	SW# 6385 "Dover White" eggshell sheen	concrete walls

**END OF SECTION 09 91 23**



**SECTION 12 22 16**  
**DRAPERY TRACK AND ACCESSORIES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES LASER CONTAINMENT SYSTEM, LASER CURTAIN AND VALANCE.**

- A. Track and track suspension products
- B. Laser Curtain
- C. Valance

**1.2 RELATED REQUIREMENTS**

- A. Section 05 50 00 - Metal Fabrications: Track supports above ceiling.
- B. Section 09 51 00 - Accoustical Ceilings; Suspended ceiling system to support track.

**1.3 REFERENCE STANDARDS**

- A. NFPA 701 TM2– Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
- B. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
- C. CAL Fire Title 19 1237.1 (Small Scale) Fire Resistance
- D. ANSI Z136 American National Standard(s) for Safe Use of Lasers
- E. International Electrotechnical Commission (IEC) CE EN 12254

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate location and installation for support of tracks with suspended ceiling, shelves, and optic tables.

**1.5 SUBMITTALS**

- A. See Section 01 30 00 for Submittal Procedures.
- B. Product Data: Provide track profiles, acceptable load data, finishes available, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate end track location, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.
- D. Contract Closeout Information: Maintenance and warranty information

**1.6 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum three years of documented experience.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Laser Curtain Track System:
  - 1. Kentek
  - 2. Substitutions: See Section 01 25 00 for Substitution Procedures.
- B. Laser Curtain
  - 1. Kentek
  - 2. Beamstop'r
- C. Valance
  - 1. Kentek
  - 2. Beamstop'r

**2.2 COMPONENTS**

- A. Laser Track Assembly and Suspension
  - 1. Minimum 16 gauge steel track system comprised of straight pieces, curves, end stops, wall and ceiling connectors. Track and connectors must have a textured black finish for a non-reflective surface.

2. Radius Corners – 26-inch radius corner which allows all curtain panels to be brought to one area for storage.
3. Roller hooks made of zinc plated, low carbon steel and dual non-wearing nylon wheels.
- B. Track Brackets: Formed steel wall type, for recessed installation, with screws and inserts for attachment.
- C. Laser Safety Curtain
  1. Curtain Fabric
    - a. FLEX-GUARD® 250W-B
    - b. ANSI Z136: rated at 425W/cm<sup>2</sup> for 100 seconds, wavelength 1070nm, 1mm diameter spot (1/e)
    - c. CE EN 12254:
  2. Extra heavy duty 0.044 inch thick flame retardant, non-fraying, chemical resistant, flexible fabric
  3. Lock stitches ensure durability and will not unravel. Seam ends are backstitched to improve strength. All seams to be pucker free and shall lay flat. Critical seams are double-stitched and backstitched to improve overall strength. All hems are French style, creating a clean and professional finish.
  4. Velcro® 1-inch black hook and loop fasteners are standard for panel and wall connections. Wall connections shall afford a “boxed” type corner for a light-tight seal.
  5. Applicable compliance labels are sewn onto each curtain panel.
  6. #1 Black steel non-reflective grommets are installed at 12-inch intervals in center of top hem.
  7. An additional 10% of curtain material is added to the overall width for fullness (draping).
  8. Bypass Entrances – Two approaching panels will bypass each other by 9 inches on a single track. Double bypass will provide an overlap of 18 inches. Eliminates need for dual-track systems.
  9. Weighted Hem – Weights are sewn into the bottom hem. Hem to be 1/2" above floor.
- D. Valance Construction
  1. Valance shall be constructed of the same material as the curtain.
  2. Valance shall be a flat panel, 12 inches in length, with 1-inch hem on all four sides with a sewn in hook and loop 1-inch Velcro® strips. Valances are made in two or more sections, depending on width, and are adjustable by approximately 9 inches greater or less than finished length.
  3. Valances should be offset from the track for best operation.

### **PART 3 EXECUTION**

#### **3.1 SITE CONDITIONS**

- A. A.Prior to installation of the Work of this Section, carefully inspect the installed Work specified in other sections and verify that all such Work is complete to the point where this installation may properly commence.
- B. Verify that all Work has been installed in complete accordance with the original design, received submittals, and the manufacturer's recommendations.
- C. In the event of discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

#### **3.2 LASER TRACK INSTALLATION**

- A. Mounting of Track Assembly:

### **3.3 INSTALLATION**

- A. Install drapery tracks in accordance with manufacturer's instructions.
  - 1. Ceiling Mounted: Provide ceiling supports for mounting track direct to ceiling structure and within intervals indicated in manufacturer's written instructions for on center spacing.
  - 2. Wall Mount Connectors: Provide wall mount hardware at walls.
- B. Track Support Spacing: Comply with manufacturer's recommendations for applied loads, and not to exceed the following dimensions between track supports:
- C. Install track for center-parting curtains with at least 24-inch (610 mm) overlap of track sections at center-line, and supported with track lap clamps.

### **3.4 LASER CURTAIN INSTALLATION**

- A. Installation of laser curtain shall be performed by installers experienced in the installation of the respective item as determined by the respective manufacturer.
- B. The laser curtain and track assembly shall be installed to prevent laser light from exiting the laser controlled area at levels above the applicable MPE level.
- C. Furnish each curtain with position contacts for connection to the laser safety system
- D. Curtain Supplier/Installer must provide any bracing necessary at ceiling. Coordinate with ceiling Manufacturer/Installer.

### **3.5 ADJUSTING**

- A. Adjust drapery hardware for smooth operation.

**END OF SECTION 12 22 16**



**SECTION 12 35 53.13**  
**METAL LABORATORY CASEWORK**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Standard painted steel cabinets and cabinet hardware to match existing Fisher brand painted steel cabinets in Basement room 008.
- B. Countertops.

**1.2 RELATED REQUIREMENTS**

- A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- C. Section 11 53 14 - Fume Extractors: Extractors attached to casework.
- D. Section 22 40 00 - Plumbing Fixtures: sink.
- E. Section 26 51 00 - Interior Lighting: Task-lighting luminaires.

**1.3 REFERENCE STANDARDS**

- A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- C. ASTM D522/D522M - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings; 2017 (Reapproved 2021).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. SEFA 2 - Installations; 2010.
- G. SEFA 3 - Laboratory Work Surfaces; 2010.
- H. SEFA 7 - Laboratory Fixtures; 2010.
- I. SEFA 8M - Laboratory Grade Metal Casework; 2016.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of casework with related items.
  - 1. Equipment and Instruments: Coordinate installation of casework with equipment and scientific instruments.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

**1.5 SUBMITTALS**

- A. Product Data: Details of materials, component dimensions and configurations, construction details, joint details, attachments; manufacturer's catalog literature on hardware and keying, accessories, and service fittings, if any.
- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any. Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.
- C. Test Reports: Independent laboratory reports showing compliance with chemical and physical resistance requirements for casework finish.
- D. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- E. Finish touch-up kit for each type and color of materials provided.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

### **1.8 WARRANTY**

- A. See Section 01 77 00 Project Closeout, for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Metal Laboratory Casework:
  - 1. Fisher Scientific; Fisherbrand Lab Furnishings
- B. Countertops:
  - 1. Fisherbrand Work Surfaces: 1" thick black phenolic

### **2.2 METAL LABORATORY CASEWORK**

- A. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
  - 1. Style: Flush overlay - square edge.
  - 2. Steel Sheet Metal:
  - 3. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7 and SEFA 8M, provide components that safely support the following minimum loads, without deformation or damage:
    - a. Base Units: 500 pounds per linear foot (744 kg/linear m) across the cabinet ends.
  - 4. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
  - 5. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
  - 6. Shelf Edges: Turned down 3/4 inch (19 mm) on each side and returned 3/4 inch (19 mm) front and back.
  - 7. Ends: Close open ends with matching construction.
  - 8. Welding: Electric spot welded; joints ground smooth and flush.
  - 9. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
    - a. Fill with sound-deadening core.
  - 10. Filler Panels: Flanged on both sides, of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
  - 11. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.

### **2.3 CABINET HARDWARE**

- A. Manufacturer's standard stainless steel wire pull matching existing cabinetry style.
- B. Finish of exposed stainless steel components: No.4 finish.

### **2.4 COUNTERTOPS**

- A. Countertops:
  - 1. Chemical Resistant Phenolic Resin
    - a. Cellulose fiber reinforced phenolic resin core with a polyurethane copolymer surface.
    - b. Panel Thickness: 1 inch (25 mm).

- c. Finish: \_\_\_\_\_smooth non-glare

## 2.5 FINISHES

- A. Sheet Steel Finish: Having chemical resistance equal to Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8M. Test applied finishes using procedures specified in ASTM D522/D522M.
1. Coating Type, New Casework: electrostatically powder coat
  2. Color: Fisherbrand White

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions and with SEFA 2.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure, with no distortion.
1. Base Cabinets: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 3/4 inch (19 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
  2. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
  3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
  4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).
- F. Separate dissimilar metals to prevent galvanic action.
- G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches (407 mm) on center.
- I. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- J. Replace units that are damaged, including those that have damaged finishes.
- K. Coordinate installation of work of this section with installation of fume hoods and laboratory equipment.
- L. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges. Make smooth transition from ADA counter height to standard counter height at location indicated on drawings.
- M. Deliver sinks in properly marked boxes, accompanied with written instructions, for supervised installation by appropriate trade contractor(s).

### 3.2 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

**3.3 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**END OF SECTION 12 35 53.13**



**SECTION 12 35 53.19**  
**WOOD LABORATORY CASEWORK**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Standard wood cabinets and cabinet hardware to match existing Kewaunee Scientific Corporation casework in Room 234.
- B. Countertops: Kewaunee 1" thick black phenolic to match existing countertops in Room 234.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 60 00 - Product Requirements: Requirements for sustainably harvested wood.
- B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- C. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- E. Section 26 51 00 - Interior Lighting for task-lighting luminaires.

**1.3 DEFINITIONS**

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches (1.066 m) above finished floor, tops of cases less than 72 inches (1.82 m) above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches (1.828 m) above finished floor and bottoms of cabinets more than 30 inches (0.762 m) but less than 42 inches (1.066 m) above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches (762 mm) above finished floor.

**1.4 REFERENCE STANDARDS**

- A. ANSI/HPVA HP-1 1994 - Hardwood Plywood
- B. ANSI A208.1-1999 – Particleboard Plywood
- C. ANSI A208.2-1994 – MDF Plywood
- D. UL - Underwriters Laboratory
- E. ASTM D552 - Bending Test
- F. NFPA 30 - Flammable and Combustible Liquids Code; 2018.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SEFA 3 - Laboratory Work Surfaces; 2010.
- I. SEFA 7 - Laboratory Fixtures; 2010.
- J. SEFA 8W - Laboratory Grade Wood Casework; 2016.

**1.5 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of casework with related items.
  - 1. Equipment and Instruments: Coordinate installation of casework with equipment and scientific instruments.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

**1.6 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements placement dimensions and tolerances, clearances required, and utility locations, if any.

Include coordinated information for laboratory equipment specified in another section and/or furnished by Owner.

- C. Test Reports: From independent laboratory indicating compliance with referenced chemical-resistance standards for cabinet finish and liner materials.
- D. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- E. Finish touch-up kit for each type and color of materials provided.

#### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
  - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
  - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" paragraph of this section.

#### **1.9 WARRANTY**

- A. See Section 01 77 00 Project Closeout for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  - 1. Ruptured, cracked, or stained finish coating.
  - 2. Discoloration, or lack of finish integrity.
  - 3. Cracking or peeling of finish.
  - 4. Failure of hardware.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Wood Laboratory Casework:
  - 1. Kewaunee Scientific Corp; \_\_\_\_: [www.kewaunee.com/#sle](http://www.kewaunee.com/#sle).
- B. Countertops:
  - 1. Kewaunee Scientific Corp; [\_\_\_\_]: [www.kewaunee.com/#sle](http://www.kewaunee.com/#sle).

#### **2.2 WOOD LABORATORY CASEWORK**

- A. Wood Laboratory Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
  - 1. Style: Match existing cabinetry in room 234.
  - 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
    - a. Base Cabinets: 22 inches (559 mm).
    - b. Tall Cabinets: 22 inches (559 mm).

- c. Upper Cabinets: 16 inches (406 mm).
- 3. Construction: Joints doweled, glued and screwed, except drawers may be lock-shoulder jointed; with interior of units smooth and flush; cabinet bottom flush with top of face frame; without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
- 4. Structural Performance: In addition to the requirements of SEFA 3, SEFA 7, and SEFA 8W, components safely support the following minimum loads:
- 5. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- 6. Factory-finish all exposed and semi-exposed surfaces with the same finish.
  - a. Finish Performance: Provide finish on all surfaces having chemical resistance of Level 0 (no change) or Level 1 (slight change of gloss or slight discoloration) according to SEFA 8W and no visible effect when surface is exposed to:
    - 1) Hot water at temperature between 190 degrees F (88 degrees C) and 205 degrees F (96 degrees C) trickled down the test surface at 45 degree angle for 5 minutes.
    - 2) Constant moisture in the form of 2 by 3 by 1 inch (51 by 76 by 25 mm) thick cellulose sponge kept continually saturated with water and in contact with test surface for 100 hours.
  - b. Preparation: Wood sanded smooth, free from dust and mill marks.
  - c. Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
  - d. Coats: Multiple coats as required to achieve minimum 1.5 mil (0.038 mm) dry film thickness.
  - e. Appearance: Clear satin gloss; not cloudy or muddy.

## 2.3 CABINET HARDWARE

- A. Manufacturer's standard styles, and as indicated below.
- B. Swinging Doors:
  - 1. Catches: Magnetic.
  - 2. Pulls: Rounded Aluminum or best match to existing
  - 3. Drawers:
    - a. Pulls: Rounded Aluminum or best match to existing.
    - b. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

## 2.4 COUNTERTOPS

- A. Countertops:
  - 1. Phenolic Chemical resistant matching existing countertop in Room 234.
    - a. Flat Surface Thickness: 1 inch (25 mm), nominal.
    - b. Surface Finish: Smooth, non-glare.
    - c. Color: Black.

## 2.5 MATERIALS

- A. Adhesives Used for Assembly: Comply with VOC limitation requirements for adhesives and sealants as specified in Section 01 61 16.
- B. Wood-Based Materials:
  - 1. Certified as sustainably harvested as specified in Section 01 60 00.
  - 2. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
  - 3. Composite Wood Panels: Containing no urea-formaldehyde resin binders.

- C. Exposed Solid Wood: Clear, dry, sound, plain sawn, selected for compatible grain and color, no defects.
- D. Exposed Hardwood Plywood: Veneer core; same species as exposed solid wood, clear, compatible grain and color, no defects. Band exposed edges with solid wood of same species as veneer.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Site Verification of Environmental Conditions:
  - 1. Do not deliver casework until the following conditions have been met:
    - a. Ceiling, overhead ductwork, piping, and lighting have been installed.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

#### **3.2 INSTALLATION**

- A. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- B. Set casework items plumb and square, securely anchored to building structure.
- C. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- D. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch ( 1.6 mm). In addition, do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
  - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
  - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
  - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).
- E. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- G. Countertops: Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.
- H. Replace units that are damaged, including those that have damaged finishes.

#### **3.3 ADJUSTING**

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

#### **3.4 CLEANING**

- A. Clean casework and other installed surfaces thoroughly.

#### **3.5 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.
- C. Repair damage that occurs prior to Date of Substantial Completion, including finishes, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**END OF SECTION 12 35 53.19**

**SECTION 21 05 00**  
**BASIC FIRE SUPPRESSION REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements applicable to all Division 21 Sections. Also refer to Division 01 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

**1.2 SCOPE OF WORK**

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. Scope of Work:
  - 1. Plumbing Work: Refer to Section 22 05 00 "Basic Plumbing Requirements".
  - 2. Fire Protection Work shall include, but is not necessarily limited to:
    - a. Extend existing wet pipe sprinkler system for areas noted on the drawings.
    - b. Furnish any required hydraulic calculations and working sprinkler drawings.
    - c. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 21 05 50.
    - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
    - e. Complete all applicable tests, certifications, forms, and matrices.

**1.3 WORK SEQUENCE**

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

**1.4 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS**

- A. Definitions:
  - 1. "Mechanical Contractors" refers to the following:
    - a. Plumbing Contractor.
    - b. Heating Contractor.
    - c. Air Conditioning and Ventilating Contractor.
    - d. Temperature Control Contractor.
    - e. Fire Protection Contractor.
    - f. Testing, Adjusting, and Balancing Contractor.
  - 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
  - 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
  - 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
  - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

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

B. General:

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

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
    - a. Boiler Feed Pumps.
    - b. Burners.
    - c. Chillers.
    - d. Computer Room Air Conditioning Units.
    - e. Condensate Return Stations.
    - f. Condensing Units.
    - g. Makeup Air Units.
    - h. Electric Humidifiers.
    - i. Gas Trains.
    - j. Package Air Handling Units.
    - k. Packaged Rooftop Units.
  2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
  3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
  4. Temperature Control Subcontractor's Responsibility:
    - a. Wiring of all devices needed to make the Temperature Control System functional.
    - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
    - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
  5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.
- D. Electrical Contractor's Responsibility:
1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
  2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
  3. Provides motor control and temperature control wiring, where so noted on the drawings.
  4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
  5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
  6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

#### **1.5 QUALITY ASSURANCE**

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

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
  2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.
- B. Qualifications:
1. Only products of reputable manufacturers are acceptable.
  2. All Contractors and subcontractors shall employ only workers skilled in their trades.
- C. Compliance with Codes, Laws, Ordinances:
1. Conform to all requirements of the City of Bozeman Codes, Laws, Ordinances and other regulations having jurisdiction.
  2. Conform to all published standards of Montana State University.
  3. Conform to all State Codes.
  4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
  5. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
  6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
  7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
  8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- D. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
  2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
  3. Pay all charges for permits or licenses.
  4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
  5. Pay all charges arising out of required inspections by an authorized body.
  6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
  7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriters' Laboratories, Inc. and approved by FM Global.
- E. Examination of Drawings:



1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
  2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
  3. Scaling of the drawings is not sufficient or accurate for determining these locations.
  4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
  5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
  6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
  7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
  8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
    - a. Any item listed as furnished shall also be installed, unless otherwise noted.
    - b. Any item listed as installed shall also be furnished, unless otherwise noted.
- F. Field Measurements:
1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.
- G. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing Revit.
  2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
  3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
  4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
  5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
  6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
  7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
  8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

**1.6 CHANGE ORDERS**

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

**1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

**1.8 WARRANTY**

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

**1.9 INSURANCE**

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

**1.10 PROJECT COMMISSIONING**

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and provide all services as described in the Commissioning Plan.

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

**PART 3 - EXECUTION**

**3.1 JOBSITE SAFETY**

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

**3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK**

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
  - 1. Covering exterior walls, interior partitions and chases.
  - 2. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
  - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
    - a. Pipe wall penetrations are sealed.
    - b. Pipe identification is installed.
    - c. Branch piping in the location of sprinklers shall be dropped to the ceiling.
  - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
  - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

**3.3 PROJECT CLOSEOUT**

- A. The following paragraphs supplement the requirements of Division 01.
- B. IDPH Final Occupancy Checklist for Request of Inspection:
  - 1. Each Contractor must submit all forms and certifications required by IDPH relating to their work at 85% completion of the project or when directed by the Owner/Architect/Engineer.
- C. Final Jobsite Observation:
  - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
  - 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- D. Before final payment is authorized, this Contractor must submit the following:
  1. Operation and maintenance manuals with copies of approved shop drawings.
  2. Record documents including marked-up or reproducible drawings and specifications.
  3. Inspection report by the State Fire Marshal of the fire protection system.
  4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; receipt by Architect/Engineer required prior to final payment approval.

### **3.4 SYSTEM STARTING AND ADJUSTING**

- A. The fire protection systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### **3.5 RECORD DOCUMENTS**

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of fire protection drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

### **3.6 ADJUST AND CLEAN**

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

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

**3.7 SPECIAL REQUIREMENTS**

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

**3.8 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION**

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
  - 1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
    - a. Minimizing the amount of dust generated.
    - b. Reducing solvent fumes and VOC emissions.
    - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
  - 2. Request that the Owner designate an IAQ representative.
  - 3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
  - 4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
  - 5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
  - 6. Request copies of and follow all of the Owner's IAQ and infection control policies.
  - 7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
  - 8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
  - 9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

**READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION**

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

- 1. Penetrations fire sealed and labeled in accordance with specifications.
- 3. Fire protection system operational.
- 4. Pipes labeled.

that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

**END OF SECTION**



**SECTION 21 05 05  
FIRE SUPPRESSION DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

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

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

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

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

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

**3.2 PREPARATION**

- A. Disconnect fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

**3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply and/or main lines.
- C. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- D. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

**3.4 CUTTING AND PATCHING**

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 21 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

**3.5 CLEANING AND REPAIR**

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

**END OF SECTION**



**SECTION 21 05 29  
FIRE SUPPRESSION SUPPORTS AND ANCHORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

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

**1.2 REFERENCES**

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- D. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
- E. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- F. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

**1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

**PART 2 - PRODUCTS**

**2.1 SEISMIC RESTRAINTS**

- A. Refer to Section 21 05 50 for additional requirements for seismic restraints.

**2.2 HANGER RODS**

- A. Hanger rods for single rod hangers supporting steel, copper, and CPVC piping shall conform to the following:

Pipe Size	Rod Size
4" and smaller	3/8"
5" 6", and 8"	1/2"
10" and 12"	5/8"

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

**2.3 PIPE HANGERS AND SUPPORTS**

- A. General:
  - 1. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58, 69, 89, and 127 (where applicable).
- B. Hangers and Clamps:
  - 1. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
  - 2. Unless otherwise indicated, hangers shall be as follows:
    - a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe
      - 1) Products: Bare Steel, Plastic or Insulated Pipe
        - a) Anvil Fig. 260
        - b) Eaton Fig. 3100
        - c) nVent Model 400
      - 2) Products: Bare Copper Pipe Felt or PVC Coated
        - a) Anvil Fig. CT65
        - b) nVent Model 402

- b. Adjustable Swivel Ring Type: Service: Bare Metal Pipe - 4 inches and Smaller
  - 1) Products: Bare Steel Pipe
    - a) Anvil Fig. 69
    - b) Eaton Fig. B3170NF
    - c) nVent Model FCN
  - 2) Products: Bare Copper Pipe
    - a) Eaton Fig. B3170CTC
    - b) nVent 102A0 Series
    - c) Anvil Fig. CT-69
- 3. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
- 4. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- 5. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
- 6. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
  - a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe
    - 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
    - 2) Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.
    - 3) Products: Bare Steel, Plastic or Insulated Pipe
      - a) Unistrut Fig. P1100 or P2500
      - b) Eaton Fig. B2000 or B2400
      - c) Anvil AS1200
      - d) nVent USC
    - 4) Products: Bare Copper Pipe
      - a) Eaton Fig. BVT
      - b) nVent CADDY Cushion Clamp
- C. Upper (Structural) Attachments:
  - 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
    - a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.)
      - 1) Products:
        - a) Anvil Fig. 86
        - b) Eaton Fig. B3033/B3034
        - c) nVent Model 300 & 310
    - b. Scissor Type Beam Clamps (for use with bar-joists and wide flange):
      - 1) Products:
        - a) Anvil Fig. 228, 292
        - b) Eaton Fig. B3054
        - c) nVent Model 360
    - c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):

1) Products:

- a) MCL. M1, M2 or M3
- d. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-[05]<Insert>. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
- e. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- f. Steel Structure Welding:
- g. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

**2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS**

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

**2.5 PIPE SLEEVES AND LINTELS**

- A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
  - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
  - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve or thermoplastic with integral water seal and textured surface.
  - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
  - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
  - 5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
T	Fire Seals (1 hour)	Silicone	-67°F to 400°F
FS	Fire Seals (3 hours)	Silicone	-67°F to 400°F
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

- 6. Manufacturers:
  - a. Thunderline Corporation "Link-Seals"
  - b. O-Z/Gedney Company
  - c. Calpico, Inc.
  - d. Innerlynx
  - e. Metraflex Company (cold service only).

**2.6 ESCUTCHEON PLATES AND TRIM**

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

**2.7 PIPE PENETRATIONS**

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

**2.8 PIPE ANCHORS**

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

**2.9 FINISH**

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

**PART 3 - EXECUTION**

**3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS**

- A. General Installation Requirements:
  - 1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
  3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
  4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
  2. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
  3. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
  4. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- C. Pipe Requirements:
1. Support all piping and equipment, including valves, strainers, and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
  2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
  3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
  4. Piping shall not introduce strains or distortion to connected equipment.
  5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
  6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
  7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
  8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
  2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
    - a. The hanger is attached within 6" from a web/chord joint.
    - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
  3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
  4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Spacing of hangers shall in no case exceed the following:
  - 1. Steel (All steel pipe unless otherwise noted):
    - a. Maximum Spacing:
    - b. 1-1/4" & under: 12'-0"
    - c. 1-1/2" & larger: 15'-0"
  - 2. Steel (Schedule 40 lightweight alternative):
    - a. Maximum Spacing:
    - b. 3" & under: 12'-0"
    - c. 3" & under: 12'-0"
  - 3. Hard Drawn Copper:
    - a. Maximum Spacing:
    - b. 1" & under: 8'-0"
    - c. 1-1/4" to 1-1/2": 10'-0"
    - d. 2" to 3": 12'-0"
    - e. 3-1/2" & larger: 15'-0"
  - 4. CPVC:
    - a. Maximum Spacing:
    - b. 3/4": 5'-6"
    - c. 1": 6'-0"
    - d. 1-1/4": 6'-6"
    - e. 1-1/2": 7'-0"
    - f. 2": 8'-0"
    - g. 2-1/2": 9'-0"
    - h. 3": 10'-0"
- I. Installation of hangers shall conform to MSS SP-58, 69, 89, and applicable NFPA standards.

**END OF SECTION**

**SECTION 21 05 50**  
**SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Seismic Requirements.

**1.2 REFERENCES**

- A. International Building Code, 2021.
- B. ASHRAE - A Practical Guide to Seismic Restraint.
- C. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
- D. NFPA 13 - Installation of Sprinkler Systems.
- E. NFPA 14 - Standpipe and Hose Systems.

**1.3 SUBMITTALS**

- A. Submittal to Code Official:
  - 1. Contractor shall submit copies of the seismic shop drawings to the governing code authority for approval.

**1.4 TESTING AND INSPECTION**

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the International Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.
- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

**1.6 DESIGN REQUIREMENTS**

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. Forces shall be calculated with the above requirements and Equation 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4.
- C. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
- D. All seismic anchorage and bracing shall comply with FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.

**1.7 COORDINATION**

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.

**1.8 WARRANTY**

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

## **PART 2 - PRODUCTS**

### **2.1 SUPPLIERS**

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
1. B-Line Systems, Inc. (800) 851-7415, [www.b-line.com](http://www.b-line.com).
  2. Unistrut Corporation <http://www.unistrut.us/>
  3. Kinetics Noise Control (877) 457-2695, [www.kineticsnoise.com](http://www.kineticsnoise.com).
  4. Mason Industries, Inc. [www.mason-ind.com](http://www.mason-ind.com).
  5. Loos & Co., Inc. (800) 321-5667, [www.loosnaples.com](http://www.loosnaples.com).
  6. Tolco (909) 737-5599, [www.tolco.com](http://www.tolco.com)
  7. ISAT 877.523.6060, [www.isatsb.com](http://www.isatsb.com)
  8. Vibro-Acoustics (416) 291-7371, <https://virs.vibro-acoustics.com/>

### **2.2 SEISMIC DESIGN CRITERIA**

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions
1. Stay in Place:
    - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.
  2. Remain Operational:
    - a. Requirements for "Stay in Place" listed above shall be met.
    - b. The following systems and associated equipment are intended not to fail externally or internally and are intended to continue operation following a seismic event:
      - 1) Fire Protection

### **2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS**

- A. General:
1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
  2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
  3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
  4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
  5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
  6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.
- B. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.

### **2.4 MATERIALS**

- A. Use the following materials for restraints:
1. Indoor Dry Locations: Steel, zinc plated.

### **2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS**

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.



- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

## **2.6 SEISMIC BRACING COMPONENTS**

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
  - 1. Materials for Channel: ASTM A 1011, GR 33.
  - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
  - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
  - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
  - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
  - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- D. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.
- E. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- F. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- G. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- H. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- I. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.

- J. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- K. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- L. Do not install cables over sharp corners.
- M. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- N. Provide reinforced clevis bolts when required.
- O. Post-Installed anchors shall be provided to meet seismic requirements.
- P. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- Q. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- R. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.
- S. Do not brace a system to two different structures such as a wall and a ceiling.
- T. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- U. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.

### **3.2 SEISMIC RESTRAINT EXCLUSIONS**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

**END OF SECTION**

**SECTION 22 05 00**  
**BASIC PLUMBING REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

**1.2 SCOPE OF WORK**

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. Scope of Work:
  - 1. Plumbing Work shall include, but is not necessarily limited to:
    - a. Furnish and install all items listed in the Plumbing Material List.
    - b. Extend existing domestic water piping system including cold, hot, and hot water circulating piping within the building. Insulate all piping as specified.
    - c. Extend existing gas piping system including all meter requirements.
    - d.
    - e. Furnish and install condensate drain piping from plumbing related equipment such as ice machines.
    - f. Extend existing sanitary sewer and vent system.
    - g. Modify existing laboratory gas systems including all piping and valves.
    - h. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 22 05 50.
    - i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
  - 2. Fire Protection Work: Refer to Section 21 05 00 "Basic Fire Suppression Requirements".

**1.3 OWNER FURNISHED PRODUCTS**

- A. Owner provided or relocated equipment shall be installed and/or connected by this Contractor:
- B. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- C. This Contractor shall make all plumbing system connections shown on the drawings or as required for fully functional units.
- D. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

**1.4 WORK SEQUENCE**

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

**1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS**

- A. Definitions:
  - 1. "Mechanical Contractors" refers to the following:
    - a. Plumbing Contractor.
    - b. Heating Contractor.
    - c. Air Conditioning and Ventilating Contractor.
    - d. Temperature Control Contractor.
    - e. Fire Protection Contractor.
    - f. Testing, Adjusting, and Balancing Contractor.

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

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

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
  5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
    - a. Light fixtures.
    - b. Gravity flow piping, including steam and condensate.
    - c. Electrical busduct.
    - d. Sheet metal.
    - e. Electrical cable trays, including access space.
    - f. Sprinkler piping and other piping.
    - g. Electrical conduits and wireway.
- C. Mechanical Contractor's Responsibility:
1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
    - a. Boiler Feed Pumps.
    - b. Burners.
    - c. Chillers.
    - d. Computer Room Air Conditioning Units.
    - e. Condensate Return Stations.
    - f. Condensing Units.
    - g. Makeup Air Units.
    - h. Electric Humidifiers.
    - i. Gas Trains.
    - j. Package Air Handling Units.
    - k. Packaged Rooftop Units.
  2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
  3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
  4. Temperature Control Contractor's Responsibility:
    - a. Wiring of all devices needed to make the Temperature Control System functional.
    - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor.
    - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
  5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.
- D. Electrical Contractor's Responsibility:
1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
  2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

#### **1.6 QUALITY ASSURANCE**

- A. Contractor's Responsibility Prior to Submitting Pricing Data:
  1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
  2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.
- B. Qualifications:
  1. Only products of reputable manufacturers are acceptable.
  2. All Contractors and subcontractors shall employ only workers skilled in their trades.
- C. Compliance with Codes, Laws, Ordinances:
  1. Conform to all requirements of the City of Bozeman Codes, Laws, Ordinances and other regulations having jurisdiction.
  2. Conform to all published standards of Montana State University.
  3. Conform to all State Codes.
  4. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
  5. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
  6. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
  7. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
  8. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
  9. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- D. Permits, Fees, Taxes, Inspections:
  1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
  3. Pay all charges for permits or licenses.
  4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
  5. Pay all charges arising out of required inspections by an authorized body.
  6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
  7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.
- E. Examination of Drawings:
1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
  2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
  3. Scaling of the drawings is not sufficient or accurate for determining these locations.
  4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
  5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
  6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
  7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
  8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
    - a. Any item listed as furnished shall also be installed, unless otherwise noted.
    - b. Any item listed as installed shall also be furnished, unless otherwise noted.
- F. Field Measurements:
1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.
- G. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing Revit.
  2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
  3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
  4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
  5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
  6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

### 1.7 SUBMITTALS

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

1. Submittals List:

Referenced Specification Section	Submittal Item
22 05 29	Hangers and Supports
22 05 50	Seismic Restraint Systems
22 05 53	Plumbing Identification
22 07 19	Plumbing Pipe Insulation
22 09 00	Instrumentation
22 10 00	Plumbing Piping Systems and Valves
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures
22 60 00	Gas Systems

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

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



- c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
  - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
  - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

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

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 22 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

**1.8 CHANGE ORDERS**

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

**1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

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

- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

**1.10 WARRANTY**

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

**1.11 INSURANCE**

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

**1.12 MATERIAL SUBSTITUTION**

- A. Where several manufacturers' names are given, the first manufacturer is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

**1.13 PROJECT COMMISSIONING**

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and provide all services as described in the Commissioning Plan.

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

**PART 3 - EXECUTION**

**3.1 JOBSITE SAFETY**

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

**3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK**

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
  - 1. Covering exterior walls, interior partitions and chases.
  - 2. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
  - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
    - a. Pipe insulation is installed and fully sealed.
    - b. Pipe wall penetrations are sealed.
    - c. Pipe identification and valve tags are installed.
  - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
  - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

**3.3 PROJECT CLOSEOUT**

- A. The following paragraphs supplement the requirements of Division 1.
- B. IDPH Final Occupancy Checklist for Request of Inspection:
  - 1. Each Contractor must submit all forms and certifications required by IDPH relating to their work at 85% completion of the project or when directed by the Owner/Architect/Engineer.
- C. Final Jobsite Observation:
  - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
  - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
  - 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- D. Before final payment is authorized, this Contractor must submit the following:
  1. Operation and maintenance manuals with copies of approved shop drawings.
  2. Record documents including marked-up or reproducible drawings and specifications.
  3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
  4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
  5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; receipt by Architect/Engineer required prior to final payment approval.

### **3.4 OPERATION AND MAINTENANCE MANUALS**

- A. General:
  1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
  1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    - a. O&M file name: O&M.div22.contractor.YYYYMMDD
    - b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD
  5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
  6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
  7. All text shall be searchable.
  8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.
- C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
  2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
  3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
  4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.
- D. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
  2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
  3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
  4. Copy of final approved test and balance reports.
  5. Copies of all factory inspections and/or equipment startup reports.
  6. Copies of warranties.
  7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
  8. Dimensional drawings of equipment.
  9. Capacities and utility consumption of equipment.
  10. Detailed parts lists with lists of suppliers.
  11. Operating procedures for each system.
  12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
  13. Repair procedures for major components.
  14. List of lubricants in all equipment and recommended frequency of lubrication.
  15. Instruction books, cards, and manuals furnished with the equipment.
  16. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

### **3.5 SYSTEM STARTING AND ADJUSTING**

- A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

- C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### **3.6 RECORD DOCUMENTS**

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of plumbing drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

### **3.7 ADJUST AND CLEAN**

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

### **3.8 SPECIAL REQUIREMENTS**

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

### **3.9 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION**

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
  - a. Minimizing the amount of dust generated.
  - b. Reducing solvent fumes and VOC emissions.
  - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
  - d. Protect stored on-site and installed absorptive materials from moisture damage.
2. Request that the Owner designate an IAQ representative.
3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
6. Request copies of and follow all of the Owner's IAQ and infection control policies.
7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

#### READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

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

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.
5. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

**END OF SECTION**



**SECTION 22 05 05**  
**PLUMBING DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

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

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

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

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

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

**3.2 PREPARATION**

- A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.
- C. Existing Plumbing System: Maintain service to all plumbing fixtures until new piping is installed. Obtain permission from Owner at least 48 hours before shutting down system for any reason. Make changeover to new piping with minimum outage. Do not disconnect any roof drainage piping until new piping is in place and operational.

**3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK**

- A. Demolish and extend existing plumbing work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.
- H. Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 1 pipe diameter from main to prevent "dead legs".

- I. Temporarily cap all openings to the sanitary and vent system to prevent odor from entering the work area and building.

**3.4 CUTTING AND PATCHING**

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 22 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

**3.5 CLEANING AND REPAIR**

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

**3.6 SPECIAL REQUIREMENTS**

- A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.
- B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

**END OF SECTION**

**SECTION 22 05 29  
PLUMBING SUPPORTS AND ANCHORS**

**PART 1 - GENERAL**

**1.1 REFERENCES**

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

**1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

**PART 2 - PRODUCTS**

**2.1 SEISMIC RESTRAINTS**

- A. Refer to Section 22 05 50 for additional requirements for seismic restraints.

**2.2 HANGER RODS**

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2-1/2" and smaller	3/8"	3/8"
3" through 3-5/8"	3/8"	3/8"
4" and 5"	1/2"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel, cast iron, and glass pipe.

Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

**2.3 PIPE AND STRUCTURAL SUPPORTS**

A. General:

- 1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
- 2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.
- 3. Copper piping located in an exposed area, , shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.
  - a. Products:
    - 1) nVent/M-Co Model #456
    - 2) Eaton Fig. 3198HCT

- 3) Anvil Fig. CT138R
- B. Vertical Supports:
1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.
    - a. Products:
      - 1) Eaton Fig B3373 Series
      - 2) nVent 510 Series
      - 3) Anvil Fig. 90
  2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.
    - a. Products:
      - 1) Mason RBA, RCA or RDA
      - 2) Mason BR
  3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.
    - a. Products:
      - 1) Pipeshields E100
  4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
  5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- C. Hangers and Clamps:
1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
  2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65°F to +275°F.
  3. Vertical cold pipe drops and rough-ins to fixtures shall be supported by insulated pipe clamps to prevent thermal bridging and condensation.
  4. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
  5. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
    - a. Products:
      - 1) Anvil Fig. 160, 161, 162, 163, 164, 165
      - 2) Eaton Fig. 3160, 3161, 3162, 3163, 3164, 3165
      - 3) nVent Model 630, 631, 632, 633, 634, 635
  6. Unless otherwise indicated, hangers shall be as follows:
    - a. Clevis Type: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches & Smaller
      - 1) Products: Bare Steel Plastic or Insulated Pipe:
        - a) Anvil Fig. 260
        - b) Eaton Fig. 3100

- c) nVent Model 400
        - 2) Products: Bare Copper Pipe Felt or PVC Coated:
          - a) Eaton Fig. B3104F or B3100CTC
          - b) Anvil Fig. CT65
          - c) nVent Fig. 402
        - b. Continuous Channel with Clevis Type: Service: Plastic Tubing, Flexible Hose, Soft Copper Tubing:
          - 1) Products:
            - a) Eaton Fig. B3106, with Fig. B3106V
            - b) nVent Model 104, with Model 104V
            - c) Anvil Fig. 1V
  - 7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
    - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
    - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
  - 8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
    - a. Clamp Type: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller
      - 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
      - 2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
      - 3) Products: Bare Steel, Plastic or Insulated Pipe:
        - a) Unistrut Fig. P1100 or P2500
        - b) Eaton Fig. B2000 or B2400
        - c) Anvil Fig. AS1200
        - d) nVent USC
      - 4) Products: Bare Copper Pipe:
        - a) nVent CADDY Cushion Clamp
- D. Upper (Structural) Attachments:
  - 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
    - a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):
      - 1) Products:
        - a) Anvil Fig. 86
        - b) Eaton Fig. B3033/B3034
        - c) nVent Model 300 & 310
    - b. Steel Structure Clamps: Scissor Type Beam Clamps (for use with bar-joists and wide flange):
      - 1) Products:
        - a) Anvil Fig. 228, 292
        - b) Eaton Fig. B3054

- c) nVent Model 360
- c. Centrally Loaded Open Web Joist Hangers (for use with bar joists):
  - 1) Products:
    - a) MCL. M1, M2 or M3
- d. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
- e. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- f. Steel Structure Welding:
  - 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.
- g. Wood Anchors: Tension wood rod hanger for suspending 3/8" threaded rod. Zinc plated carbon steel.
  - 1) Minimum allowable tension loads for Douglass Fir/Southern Pine:
    - a) 3/8" diameter rod; 2-1/2" shank: 600 lb/590 lb.
    - b) Load values are based on full shank penetration into wood member. Minimum edge distance 3/4". Minimum end distance 3-1/4".
  - 2) Limitations:
    - a) Truss: Do not hang from wood trusses without truss manufacturer or Structural Engineer™™s approval.
    - b) Sheetrock/Gypsum Ceiling: When drilling through non-wood materials (e.g., sheet rock, gypsum, etc.), increase shank length by depth of non-wood materials.
    - c) Plywood Flooring/Roofing: Do not hang from plywood floor or roofing.
    - d) Spacing: Refer to wood structure spacing of hangers.
  - 3) Products:
    - a) Simpson RWV
    - b) DeWALT
    - c) ITI Sammys GT25

#### 2.4 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
  - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
  - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120°F, sleeves may be thermoplastic with integral water seal and textured surface.
  - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
  - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
  - 5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
T	High/Low Temperature (Steam)	Silicone	-67°F to 400°F
T	Fire Seals (1 hour)	Silicone	-67°F to 400°F
FS	Fire Seals (3 hours)	Silicone	-67°F to 400°F
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

- 6. Manufacturers:
  - a. Thunderline Corporation "Link-Seals"
  - b. O-Z/Gedney Company
  - c. Calpico, Inc.
  - d. Innerlynx
  - e. Metraflex Company (cold service only)

**2.5 ESCUTCHEON PLATES AND TRIM**

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

**2.6 PIPE PENETRATIONS**

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

## **2.7 PIPE ANCHORS**

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

## **2.8 FINISH**

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

## **PART 3 - EXECUTION**

### **3.1 PLUMBING SUPPORTS AND ANCHORS**

- A. General Installation Requirements:
  - 1. Install all items per manufacturer's instructions.
  - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
  - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
  - 4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
  - 1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
  - 2. Set all concrete inserts in place before pouring concrete.
  - 3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
  - 4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
  - 5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- C. Pipe Requirements:
  - 1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
  - 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
  - 3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
  - 4. Piping shall not introduce strains or distortion to connected equipment.
  - 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
  - 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
  - 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
  - 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
  - 1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
  - 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
    - a. The hanger is attached within 6" from a web/chord joint.



- b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
  3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
  4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" & under: 7'-0"
      - 2) 1-1/2": 9'-0"
      - 3) 2": 10'-0"
      - 4) 2-1/2": 11'-0"
      - 5) 3": 12'-0"
      - 6) 4" & larger: 12'-0"
  2. Steel (Std. Weight or Heavier - Vapor Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" and under: 9'-0"
      - 2) 1-1/2": 12'-0"
      - 3) 2" & larger: 12'-0"
  3. Hard Drawn Copper & Brass (Liquid Service):
    - a. Maximum Spacing:
      - 1) 3/4" and under: 5'-0"
      - 2) 1": 6'-0"
      - 3) 1-1/4": 7'-0"
      - 4) 1-1/2" 8'-0"
      - 5) 2": 8'-0"
      - 6) 2-1/2": 9'-0"
      - 7) 3": 10'-0"
      - 8) 4": 12'-0"
      - 9) 6": 12'-0"
  4. Hard Drawn Copper & Brass (Vapor Service):
    - a. Maximum Spacing:
      - 1) 3/4" & under: 7'-0"
      - 2) 1": 8'-0"
      - 3) 1-1/4": 9'-0"
      - 4) 1-1/2": 10'-0"
      - 5) 2": 11'-0"
      - 6) 2-1/2" & larger: 12'-0"
  5. Plastic Pipe:
    - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
  6. Ultra-Flexible Pipe, and Flexible Hose, and Soft Copper Tubing:

- a. Continuous channel with hangers maximum 8'-0" OC.
- I. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
  - 1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" & under: 7'-0"
      - 2) 1-1/2": 9'-0"
      - 3) 2": 10'-0"
      - 4) 2-1/2": 11'-0"
      - 5) 3": 12'-0"
      - 6) 4" through 6": 12'-0"
      - 7) 8": 9'-0"
      - 8) 10": 6'-0"
      - 9) 12": 4'-0"
  - 2. Steel (Std. Weight or Heavier - Vapor Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" and under: 9'-0"
      - 2) 1-1/2": 12'-0"
      - 3) 2" & larger: 12'-0"
      - 4) 2-1/2": 11'-0"
      - 5) 3": 12'-0"
      - 6) 4" through 8": 12'-0"
      - 7) 10": 9'-0"
      - 8) 12": 6'-0"
  - 3. Hard Drawn Copper & Brass (Liquid Service):
    - a. Maximum Spacing:
      - 1) 3/4" and under: 5'-0"
      - 2) 1": 6'-0"
      - 3) 1-1/4": 7'-0"
      - 4) 1-1/2" 8'-0"
      - 5) 2": 8'-0"
      - 6) 2-1/2": 9'-0"
      - 7) 3": 10'-0"
      - 8) 4": 12'-0"
      - 9) 6": 12'-0"
  - 4. Hard Drawn Copper & Brass (Vapor Service):
    - a. Maximum Spacing:
      - 1) 3/4" & under: 7'-0"
      - 2) 1": 8'-0"
      - 3) 1-1/4": 9'-0"
      - 4) 1-1/2": 10'-0"
      - 5) 2": 11'-0"
      - 6) 2-1/2" & larger: 12'-0"
  - 5. Plastic Pipe:
    - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
  - 6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
    - a. Continuous channel with hangers maximum 8'-0" OC.
- J. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
  - 1. Plastic Pipe:
    - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

- K. Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.

**END OF SECTION**



**SECTION 22 05 50**  
**SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Seismic Requirements.

**1.2 REFERENCES**

- A. International Building Code, 2021.
- B. ASHRAE - A Practical Guide to Seismic Restraint.
- C. Technical Manual 5-809-10, NAVFAC P-355, Air Force Manual 88-3, Chapter 13.
- D. NFPA 13 - Installation of Sprinkler Systems.
- E. NFPA 14 - Standpipe and Hose Systems.

**1.3 TESTING AND INSPECTION**

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.
- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

**1.5 DESIGN REQUIREMENTS**

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. Forces shall be calculated with the above requirements and Equations 16-67, 68, & 69 in section 1621.1.4 of IBC 2000, unless exempted by 1621.1.1 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4.
- C. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
- D. All seismic anchorage and bracing shall comply with the St. Louis County Rules & Regulations on Anchorage & Sway Bracing - Mechanical, Electrical & Plumbing (MEP) System Components.
- E. All seismic anchorage and bracing shall comply with FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.

**1.6 COORDINATION**

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

**1.7 WARRANTY**

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

## **PART 2 - PRODUCTS**

### **2.1 SUPPLIERS**

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
  2. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
  3. Mason Industries, Inc. www.mason-ind.com.
  4. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.

### **2.2 SEISMIC DESIGN CRITERIA**

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions:
1. Stay in Place:
    - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.
  2. Remain Operational:
    - a. Requirements for "Stay in Place" listed above shall be met.
    - b. The following systems and associated equipment are intended not to fail externally or internally and are intended to continue operation following a seismic event:
      - 1) Plumbing
      - 2) Medical Gas

### **2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS**

- A. General:
1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
  2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
  3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
  4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
  5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
  6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.
- C. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.
- D. Housekeeping Pads:
1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

### **2.4 MATERIALS**

- A. Use the following materials for restraints:
1. Indoor Dry Locations: Steel, zinc plated.
  2. Outdoors and Damp Locations: Galvanized steel.
  3. Corrosive Locations: Stainless steel.

### **2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS**

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

## **2.6 SEISMIC BRACING COMPONENTS**

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
  1. Materials for Channel: ASTM A 1011, GR 33.
  2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
  3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
  4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
  1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
  2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- C. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.
- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.

- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.
- U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.
- V. Brace all terminal units with water coils as required by the building code and provide flexible connection to the coil if bracing is required.
- W. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.
- X. Do not brace a system to two different structures such as a wall and a ceiling.
- Y. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- Z. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- AA. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- BB. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

### **3.2 SEISMIC RESTRAINT EXCLUSIONS**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

### **END OF SECTION**



**SECTION 22 05 53  
PLUMBING IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 22.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM B-1, B-3, and B-8 for copper conductors.
- C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 " 2kV Cables.
- D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
- E. NFPA-99: Health Care Facilities.
- F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 22 05 00. Include list of items identified, wording, letter sizes, and color coding.
- B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- 1. 3M
- 2. Bunting
- 3. Calpico
- 4. Emedco
- 5. Kolbi Industries
- 6. Seton
- 7. W.H. Brady
- 8. Marking Services

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

- H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.
- I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
- J. Tracer Wire:
  - 1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
  - 2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.
  - 3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
  - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
  - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
  - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
  - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
  - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
  - 6. Number all tags and show the service of the pipe.
  - 7. Provide two sets of laminated 8-1/2" x 11" (letter size) copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
  - 3. Stencil Painted Pipe Markers:
    - a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
    - b. Apply primer on non-insulated pipes before painting.
    - c. Use background and letter colors as scheduled later in this section.
  - 4. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.
  - 5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.
- E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

### **3.2 SCHEDULE**

- A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:
  1. CONDENSATE DRAIN: White lettering; green background
  2. COMPRESSED AIR: White lettering; green background
  3. DOMESTIC COLD WATER: White lettering; green background
  4. DOMESTIC HOT WATER: White lettering; green background
  5. SANITARY SEWER: Black lettering; yellow background
  6. VENT: Black lettering; yellow background
  7. VACUUM: Black lettering; white background
  8. NITROGEN: White lettering; black background
  9. HELIUM: White lettering; blue background

**END OF SECTION**



**SECTION 22 07 19  
PLUMBING PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Piping Insulation.

**1.2 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- C. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- D. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- E. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- F. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- G. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- H. ASTM E84 - Surface Burning Characteristics of Building Materials.
- I. NFPA 255 - Surface Burning Characteristics of Building Materials.
- J. UL 723 - Surface Burning Characteristics of Building Materials.
- K. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

**PART 2 - PRODUCTS**

**2.1 INSULATION**

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
- B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534 Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.
- C. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.
- D. Type F: Phenolic insulation; ASTM C1126; maximum 'K' value of 0.22 at 75°F; density 3.75lb/ft; minimum compressive strength 50 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -290°F to +250°F.

**2.2 VAPOR BARRIER JACKETS**

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

**2.3 JACKET COVERINGS**

- A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Stainless Steel Jackets: ASTM C1767. Type 316 stainless steel; 0.010" thick (thicker where required by ASTM C1729); smooth finish with Z edge seams and stainless steel bands for outdoor use.

- C. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

#### **3.2 INSTALLATION**

- A. General Installation Requirements:
  - 1. Install materials per manufacturer's instructions, building codes and industry standards.
  - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
- B. Insulated Piping Operating Below 60°F:
  - 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
  - 2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
  - 3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
  - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Exposed Piping:
  - 1. Locate and cover seams in least visible locations.
  - 2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
  - 3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping shall be insulated unless local code allows it to be uninsulated. In no instance should the uninsulated portion of the piping be more than 4ft in developed length.

#### **3.3 SUPPORT PROTECTION**

- A. Provide a shield on all insulated piping at each support between the insulation jacket and the support.
- B. On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:
  - 1. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
    - a. Molded hydrous calcium silicate (only use for pipes with operating temperatures above 90°F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
    - b. As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
      - 1) Products:
        - a) Buckaroo CoolDry
        - b) Cooper/B-Line Fig. B3380 through B3384
        - c) Pipe Shields A1000, A2000

- c. Insulation Couplings:
  - 1) Molded thermoplastic slip coupling, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
  - 2) Horizontal Strut Mounted Insulated Pipe Manufacturers:
    - a) Klo-Shure or equal
  - 3) Vertical:
    - a) Manufacturers: Klo-Shure Titan or equal
- d. Rectangular blocks, plugs, or wood material are not acceptable.
- e. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

- C. Neatly finish insulation at supports, protrusions, and interruptions.
- D. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
- E. Shields shall be at least the following lengths and gauges:

Pipe Size	Shield Size
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge
5" to 6"	18" long x 16 gauge
8" to 14"	24" long x 14 gauge
16" to 24"	24" long x 12 gauge

- F. Ferrous hot piping 4 inches and larger, provide steel saddle at rollers as described in Section 22 05 29 "Plumbing Supports and Anchors".
- G. Minimum 1/4" rolled galvanized steel plates shall be provided in addition to the sleeves as reinforcement on large pipes to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength. Refer to section above for exact locations.

### 3.4 INSULATION

- A. Type A Insulation:
  - 1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
  - 2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
  - 3. Apply insulation with laps on top of pipe.
  - 4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F seal fitting covers with vapor retarder mastic in addition to tape.
- B. Type B Insulation:
  - 1. Install per manufacturer's instructions or ASTM C1710.

2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:
  - a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
  - b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
4. Insulation Installation on Valves and Pipe Specialties:
  - a. Install preformed sections of same material as straight segments of pipe insulation when available.
  - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- C. Type C Insulation:
  1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
  2. Insulate fittings with prefabricated fittings.
- D. Type D Insulation:
  1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
  2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.
- E. Type E Insulation:
  1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
  2. Insulate pipe fittings with prefabricated insulation fittings.
- F. Type F Insulation:
  1. Seal all longitudinal joints with manufacturer approved adhesive or mastic. Secure butt joint strips in a similar manner.
  2. Indoors, above grade or below grade, polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
  3. Insulate pipe fittings with prefabricated insulation fittings.

### **3.5 JACKET COVER INSTALLATION**

- A. Metal Covering:
  1. Provide vapor barrier as specified for insulation type. Cover with stainless steel jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
  2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.
  3. Interior joints do not need to be sealed.
  4. Use metal covering on the following pipes:
    - a. All exposed piping in finished spaces unless noted otherwise on the drawings.
    - b. All exposed piping in unfinished areas as noted on drawings (e.g., storage rooms, janitor's closets, utility rooms, etc.).



- c. All exposed piping in mechanical or equipment rooms below 8'-0" above floor.
  - d. All exposed piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
  - e. All exposed piping in tunnels designated as passageways, equipment access, or egress.
  - f. All Type D insulation.
5. Use colored aluminum jacket covers on the following pipes:
- a. All exterior piping.
- B. Plastic Covering:
- 1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
  - 2. Solvent weld all joints with manufacturer recommended cement.
  - 3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
  - 4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.
  - 5. Use plastic insulation covering on all exposed pipes including, but not limited to:
    - a. All exposed piping in finished spaces unless noted otherwise on the drawings.
    - b. All exposed piping in unfinished areas as noted on drawings (e.g., storage rooms, janitor's closets, utility rooms, etc.).
    - c. All exposed piping in mechanical or equipment rooms below 8'-0" above floor.
    - d. All exposed piping in mechanical rooms that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
    - e. All exposed piping in tunnels designated as passageways, equipment access, or egress.
  - 6. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.
  - 7. Use colored plastic covering on the following pipes:
    - a. All exterior piping.

### 3.6 SCHEDULE

- A. Refer to drawings for insulation schedule.

**END OF SECTION**



**SECTION 22 10 00  
PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Check Valves.
- D. Helium System.
- E. Compressed Air System.
- F. Vacuum System.
- G. Nitrogen System.

**1.2 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- C. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

**1.3 REFERENCES**

- A. ANSI/ASME A112.3.1 - Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.
- B. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
- C. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- G. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- H. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- I. ANSI/ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- J. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- K. ANSI/ASTM B32 - Solder Metal.
- L. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- M. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- N. ANSI/AWS D1.1 - Structural Welding Code.
- O. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- P. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- Q. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- R. ANSI/AWWA C153 - Compact Ductile Iron Fittings 3" through 48", for Water and Other Liquids.
- S. ASME - Boiler and Pressure Vessel Code.
- T. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- U. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- V. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.
- W. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- X. ASTM A312 - Standard for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- Y. ASTM A554 - Standard for Welded Stainless Steel Mechanical Tubing.
- Z. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
- AA. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.

- BB. ASTM B88 - Seamless Copper Water Tube.
- CC. ASTM B306 - Copper Drainage Tube (DWV).
- DD. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- EE. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- FF. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- GG. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- HH. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- II. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- JJ. ASTM D2661 - ABS DWV Pipe & Fittings.
- KK. ASTM D2665 - PVC DWV Pipe & Fittings.
- LL. ASTM D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
- MM. ASTM D3033 - Type PSP (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
- NN. ASTM D3034 - Type PSM (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
- OO. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
- PP. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- QQ. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- RR. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.
- SS. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- TT. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- UU. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- VV. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
- WW. AWS A5.8 - Brazed Filler Metal.
- XX. AWWA C651 - Disinfecting Water Mains.
- YY. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- ZZ. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- AAA. FM 1680 - Couplings Used in Hubless Cast Iron Systems.
- BBB. NFPA 24 - Private Fire Service Mains and Their Appurtenances.
- CCC. NFPA 54 - National Fuel Gas Code.
- DDD. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
- EEE. NSF - National Sanitation Foundation

#### **1.4 SUBMITTALS**

- A. Submit shop drawings per Section 22 05 00.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store valves in shipping containers with labeling in place.

#### **1.6 COORDINATION DRAWINGS**

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

### **PART 2 - PRODUCTS**

#### **2.1 CAST IRON PIPE**

- A. Cast Iron; Standard Weight; Hub and Spigot Joints:
  1. Pipe: Standard weight hub and spigot cast iron soil pipe, bituminous corrosion protective coating inside and outside, CISPI 301 or ASTM A888.
  2. Design Pressure: Gravity Maximum Design Temperature: 180°F
  3. Joints: Compression gasket, ASTM C564.

4. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 301. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
  5. Adapters: Heavy duty no-hub transition for joining cast iron and PVC pipe. Adapters shall be tested and certified to ASTM C 1460 and be constructed with Type 304 stainless steel shield, thickness 0.015" shield, gasket material to meet ASTM C564, 1-1/2" to 4" will be 3" wide with four 304 stainless steel bands, and 6" to 10" will be 4" wide with six 304 stainless steel bands and 3/8" 305 stainless steel hex head screws torqued to 80 inch pounds.
- B. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets:
1. Pipe: Standard weight no-hub cast iron soil pipe, bituminous corrosion protective coating inside and outside, CISPI 301 or ASTM A888.
  2. Design Pressure: Gravity Maximum Design Temperature: 180°F
  3. Joints: ASTM C1540, FM 1680, and ASTM C-564.
    - a. Super Duty, Shielded Stainless Steel Couplings: Neoprene sleeve gasket, 0.015" thick 304 stainless steel shield , stainless steel 3/8" screw type clamps, minimum of four clamps for 1-1/2" to 4" and six clamps for 5" and larger pipe sizes. Clamps shall be tightened to minimum 80 inch pounds or as manufacturer requires. Husky SD-4000 or equal.
    - b. Heavy Duty, Shielded Stainless Steel Couplings: Neoprene sleeve gasket, 0.010" thick 304 stainless steel shield , stainless steel 5/16" screw type clamps, minimum of four clamps for 1-1/2" to 4" and six clamps for 5" and larger pipe sizes. Clamps shall be tightened to minimum 80 inch pounds or as manufacturer requires. Husky HD-2000 or equal.
  4. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 310. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
  5. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters specifically for the application. Adapter must meet the same requirements as the joints listed above. ASTM C1460. Sticker identifying transition fitting application must be visible to view.
- C. Cast Iron; Standard Weight Epoxy Coated; No-Hub Sleeve Gaskets:
1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, epoxy paint corrosion protective coating inside and outside, CISPI 301 or ASTM A888.
  2. Joints: ASTM C1540 and FM 1680.
    - a. Super Duty, Shielded Stainless Steel Couplings: Neoprene sleeve gasket, 0.015" thick 304 stainless steel shield , stainless steel 3/8" screw type clamps, minimum of four clamps for 1-1/2" to 4" and six clamps for 5" and larger pipe sizes. Clamps shall be tightened to minimum 80 inch pounds or as manufacturer requires. Husky SD-4000 or equal.
    - b. Corrosion Resistant, Shielded Stainless Steel Couplings: Neoprene sleeve gasket, 0.015" thick 316 stainless steel shield , 316 stainless steel 3/8" screw type clamps, minimum of four clamps for 1-1/2" to 4" and six clamps for 5" and larger pipe sizes. Clamps shall be tightened to minimum 80 inch pounds or as manufacturer requires. Husky CR-7000 or equal.
  3. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 301. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
  4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters specifically for the application. Adapter must meet the same requirements as the joints listed above. ASTM C1460. Sticker identifying transition fitting application must be visible to view.

## 2.2 COPPER PIPE

- A. Copper Pipe; Type L; Solder Joints:
  - 1. Pipe: Type L hard drawn seamless copper tube, ASTM B88.
  - 2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
  - 3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
  - 4. Fittings: Wrought copper solder joint, ANSI B16.22.
- B. Copper Pipe; Type L; Mechanical Press Connection:
  - 1. Pipe: Type L hard drawn seamless copper tube, ASTM B88.
  - 2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
  - 3. Joints: Mechanical press connection.
  - 4. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.
  - 5. Fitting Identification: Press ends shall provide the ability to identify an unpressed fitting from the floor prior to testing. The function of this feature is to provide the installer quick and easy identification of connections that have not been pressed prior to putting the system into operation.
  - 6. Special Requirements: Mechanical press fitting manufacturer shall provide Contractor training prior to installation.
  - 7. Manufacturers:
    - a. Viega ProPress
    - b. Elkhart Xpress
    - c. Nibco Press System Fittings and Valves
    - d. Merit Brass
    - e. Mueller Streamline PRS
- C. Copper Pipe; Type L; Mechanically Coupled Grooved Joints:
  - 1. Pipe: Type L hard drawn seamless copper tube, ASTM B88, roll grooved per mechanical coupling manufacturers specifications.
  - 2. Design Pressure: 300 psi; Maximum Design Temperature: 180°F.
  - 3. Joints: Mechanically coupled grooved type.
  - 4. Mechanical Couplings: Ductile iron, ASTM A-536, (Grade 65-45-12), rigid grooved type cast with offsetting angle-pattern bolt pads, coated with non-toxic, no-lead paint, ASTM A449 compliant bolts and hex nuts zinc electroplated plated, ASTM B-633. Installation ready, for direct stab installation without field disassembly.
  - 5. Gaskets: Molded pressure responsive design, center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. Fluoroelastomer Grade P or EPDM Grade E, ASTM D-2000, suitable for domestic water with temperatures ranging from 32°F to 180°F.
  - 6. Fittings: Copper, ASTM B-75 and ANSI B-16.22, full flow wrought copper or cast bronze ANSI B16.18, manufactured by mechanical coupling manufacturer to copper tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted).
  - 7. Flanges: Grooved end type, Ductile iron, ASTM A-536, (Grade 65-45-12), Flange shall conform to ANSI Class 125 cast iron and Class 150 steel flange bolt hole pattern, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633.
    - a. Flange adapters to be used for connecting grooved piping to equipment flanges only. Grooved flange adapters shall not be used to connect lug style valves to grooved piping.
  - 8. System shall be UL classified in accordance with NSF-61 for potable water service, and meet the lead content requirements of NSF-372.
  - 9. Manufacturers:
    - a. Gruvlok
    - b. Victaulic
    - c. Grinnell
    - d. Shurjoint
- D. Copper Pipe; Type K; Solder Joints:
  - 1. Pipe: Type K annealed copper tube, ASTM B88.

2. Design Pressure: 150 psi. Maximum Design Temperature: 200°F.
  3. Joints: Solder with 100% lead-free solder and flux ASTM B32.
  4. Fittings: Wrought copper solder joint, ANSI B16.22.
- E. Copper Pipe; Type K; Mechanical Press Connection:
1. Pipe: Type K annealed copper tube, ASTM B88.
  2. Design Pressure: 150 psi. Maximum Design Temperature: 200°F.
  3. Joints: Mechanical press connection.
  4. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.
  5. Fitting Identification: Press ends shall provide the ability to identify an unpressed fitting from the floor prior to testing. The function of this feature is to provide the installer quick and easy identification of connections that have not been pressed prior to putting the system into operation.
  6. Special Requirements: Mechanical press fitting manufacturer shall provide contractor training prior to installation.
  7. Manufacturers:
    - a. Viega ProPress
    - b. Elkhart Xpress
    - c. Nibco Press System Fittings and Valves
    - d. Merit Brass
    - e. Mueller Streamline PRS.
- F. Copper Pipe: Type DWV; Solder Joints:
1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.
  2. Design Pressure: Gravity Maximum Design Temperature: 180°F
  3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
  4. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.
- G. Copper Pipe: Type M; Solder Joints:
1. Pipe: Type M hard temper seamless copper drainage tube, ASTM B306.
  2. Design Pressure: Gravity Maximum Design Temperature: 180°F
  3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
  4. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

### **2.3 DUCTILE IRON PIPE**

- A. Ductile Iron Pipe; Pressure Water Pipe; Push-On Joints - Pressure Pipe:
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.
  2. Design Pressure: 200 psi. Maximum Design Temperature: 150°F.
  3. Fittings: Ductile iron, ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.
  4. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.
- B. Ductile Iron Pipe; Pressure Water Pipe; Mechanical Joints:
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.
  2. Design Pressure: 200 psi. Maximum Design Temperature: 150°F.
  3. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.
  4. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

### **2.4 PLASTIC PIPE**

- A. Chlorinated Polyvinyl Chloride (CPVC); Schedule 40 Drainage; Solvent Weld Joints:
1. Pipe: Chlorinated polyvinyl chloride (CPVC) Schedule 40 drainage pipe, ASTM F1412, NSF Listed.
  2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer, ASTM F493.

3. Fittings: Chlorinated polyvinyl chloride (CPVC) DWV pattern with socket ends for Schedule 40 pipe.
4. Limitations: CPVC shall not be used in a return air plenum unless it is specifically listed to ASTM E84 and/or UL723. CAN ULC S102.2 listing is not acceptable.
5. Special Requirements: Provide expansion loop(s) and/or expansion joints in the piping system per the manufacturer's guidelines and as shown on the drawings. Refer to Section 22 05 16 for expansion joint requirements.

## **2.5 STAINLESS STEEL PIPE**

- A. Stainless Steel; Schedule 5; Type 316; Mechanical Press Connection:
  1. Pipe: Schedule 5 Type 316 stainless steel, ASTM A312 and ASTM A554 in copper tube size conforming to ASTM B88.
  2. Joints: Mechanical press connections.
  3. Fittings: Type 316 stainless steel, ASTM B88 and ANSI B16.22 with embedded O-ring. NSF-61 stainless steel grip ring for 2 1/2" to 4" diameter sizes.
  4. Transitions to other materials: Provide dielectric connection as required in this section. Refer to article "CONNECTIONS BETWEEN DISSIMILAR METALS."
  5. Fitting Identification: Press ends shall provide the ability to identify an unpressed fitting from the floor prior to testing. The function of this feature is to provide the installer quick and easy identification of connections that have not been pressed prior to putting the system into operation.
  6. Special Requirements: Mechanical press fitting manufacturer shall provide contractor training prior to installation.
  7. Manufacturers:
    - a. Merit Brass
    - b. Viega ProPress
- B. Stainless Steel; 304; Mechanically Coupled Grooved Joints:
  1. Design Pressure: Varies with size and schedule of pipe; consult coupling manufacturer's most recent submittals.
  2. Pipe: 304 stainless steel, ASTM A312, Schedule 40S, grooved in accordance with coupling manufacturer™™s standards.
  3. Couplings Potable Water: Two ASTM A536 ductile iron housing segments, pressure responsive elastomer gasket Grade P fluoroelastomer blend and required stainless steel bolts and nuts. Design Basis Potable Water: Victaulic Style 807N.
  4. Couplings Non-Potable Water: Two ASTM A536 ductile iron housing segments, pressure responsive elastomer gasket blend Grade E EPDM and required stainless steel bolts and nuts. Design Basis Non-Potable Water: Victaulic Style 107V.
  5. Fittings: ASTM A403 wrought stainless steel or factory manufactured from ASTM A312 stainless steel pipe.
- C. Stainless Steel; Type 304; Hub and Spigot Joint:
  1. Pipe: Stainless Steel Type 304, ASME A112.3.1
  2. Fittings: Stainless Steel Type 304, ASME A112.3.1, push-on joints.
  3. Joints: Push-on joint with integral rubber gaskets suitable for use with acid waste piping.
  4. Adapters: Transition from stainless steel pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C564, 300 Series stainless steel shield, clamp and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
  5. Manufacturers:
    - a. Blucher
    - b. Watts
    - c. Josam
    - d. Approved equivalent
- D. Stainless Steel; Type 316; Hub and Spigot Joint:
  1. Pipe: Stainless Steel Type 316L, ASME A112.3.1



2. Design Pressure: Gravity. Design Temperature: 200°F minimum.
3. Fittings: Stainless Steel Type 316L, ASME A112.3.1, push-on joints.
4. Joints: Push-on joint with integral rubber gaskets suitable for use with greasy waste typical for kitchen grease sanitary applications.
5. Adapters: Transition from stainless steel pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C564, 300 Series stainless steel shield, clamp and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
6. Manufacturers:
  - a. Blucher
  - b. Watts
  - c. Josam
  - d. Approved equivalent

## 2.6 VALVES

### A. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
2. Gate Valves:
  - a. GA-1: 2" and under, 150# steam @ 406°F, 300# CWP @ 150°F, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, Nibco T-131.
  - b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi CWP @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, Nibco F-617-0.
  - c. GA-7: 2-1/2" thru 12", 200# CWP @ 150°F, flanged, iron body, bronze trim, OS&Y. Crane #475-1/2, Hammond #IR1146, Stockham #G624, Walworth #8727F, Milwaukee #F2891, Nibco F-617-0.
  - d. GA-12: 2-1/2" thru 12", 200# CWP, hub ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-5, Kennedy #56.
  - e. GA-13: 2" thru 12", 200# CWP, mechanical joint ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-20, Kennedy #571X.
3. Butterfly Valves:
  - a. BF-1:
    - 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or stainless steel disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

- 2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, aluminum-bronze or stainless steel disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Stockham LD722-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.
- 3) Mechanically coupled grooved end valves are acceptable if they have the features listed above.
  - a) Cast brass body to UNS C87850. (Alloy code shall be cast or stamped into the valve body.) Aluminum bronze disc to UNS C95500, with pressure responsive elastomer seat. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Victaulic #608.
  - b) Grooved end stainless steel body and disc, Grade CF8M, conforming to ASTM A351, with blow-out proof 17-4PH stainless steel stems to ASTM A564. Disc shall be connected to the stem without the use of fasteners or pins, and be offset from the stem centerline to provide a full 360-degree continuous contact with the seating surface when closed. Seat shall be pressure responsive, Grade P fluoroelastomer. Victaulic Series 861 Vic-300 MasterSeal Valve.
4. Ball Valves:
  - a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.
    - 1) Provide solid extended shaft for all insulated piping.
    - 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
  - b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Stockham #3951-CS-R-66-LL, Nibco #F510-CS/66, Milwaukee #F90.
    - 1) Provide extended shaft for all valves in insulated piping.
    - 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
  - c. BA-9: 2" and under, 150 psi saturated steam, 600 psi CWP, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-255-FB-P-UL, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

- 1) Provide solid extended shaft for all valves in insulated piping.
  - d. BA-11: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. A.Y. McDonald 6100 Series, Mueller 300 Series.
  - e. BA-12: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. Minneapolis Pattern threaded top. A.Y. McDonald 6100 Series, Mueller 300 Series.
- B. Throttling Valves
1. Globe Valves:
    - a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.
    - b. GL-2: 2-1/2" thru 10", 125# steam @ 353°F, 200# CWP @ 150°F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.
  2. Plug Valves:
    - a. PL-1: 2" and under, 125# steam @ 450°F, 175# CWP @ 180°F, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.
    - b. PL-2: 2-1/2" thru 4", 125# steam @ 450°F, 175# CWP @ 180°F, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.
    - c. PL-3: 6" and larger, 125# steam @ 450°F, 175# CWP, cast iron body, flanged, resilient faced plug, gear and handwheel operator, full port. Walworth #1700F, DeZurik #118, F-RS24.
    - d. PL-13: 2" and under, 175# CWP, 250°F elastomer, screwed, bronze body, resilient plug facing (RS-55), adjustable memory stop, non-removable lever handle. DeZurik #120-S.
    - e. PL-15: 2-1/2" thru 8", 150# CWP, 250°F elastomer, flanged, bronze body, resilient plug facing (RS-55 or RS-56), adjustable memory stop. DeZurik #120-F.

## 2.7 CHECK VALVES

- A. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
- B. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.
- C. CK-5: 2" and under, 250# CWP, screwed, all iron, horizontal swing. Crane #346-1/2.
- D. CK-6: 2-1/2" thru 12", 125# steam @ 450°F, 200# CWP @ 150°F, flanged, all iron, horizontal swing. Crane #373-1/2, Hammond #IR1126, Stockham #G933, Walworth #8928-1/2F, Milwaukee #F-2971, Watts #F-511-R, Nibco F-918N.
- E. CK-7: Grooved End Check Valves, 2-1/2", 300 psi, grooved end Grade CF8M stainless steel body and disc, 17-4PH stainless steel shaft, with 17-4PH or 316 stainless steel spring, and Grade P fluoroelastomer seat. Suitable for vertical or horizontal installation.
- F. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG-970 BUNA, NIBCO W-920-W, Crane.
- G. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

- H. CK-20: 2" and larger, 125# CWP, flanged, iron body, cast iron or carbon steel body with stainless steel internals. Hoerbiger Design "CT". Note: Use only for compressor discharge.

**2.8 VALVE CONNECTIONS**

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

**2.9 CONNECTIONS BETWEEN DISSIMILAR METALS**

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel and stainless steel are commonly used and require isolation from each other with the following exceptions:
  - 1. Iron and steel connected to each other.
  - 2. Brass, copper, and bronze connected to each other.
  - 3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed and/or Grooved Joints (acceptable up to 4" size):
  - 1. Dielectric waterway rated for 300 psi CWP and 225°F.
  - 2. Optional: Copper-silicon casting conforming to UNS C87850 with grooved and/or threaded ends.
  - 3. UL classified in accordance with ANSI / NSF-61 for potable water service.
  - 4. Manufacturers:
    - a. Elster Group ClearFlow fittings
    - b. Victaulic Series 647
    - c. Grinnell Series 407
    - d. Matco-Norca
- F. Flanged Joints (any size):
  - 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
  - 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
  - 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
  - 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
  - 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
  - 6. Manufacturers:
    - a. EPCO
    - b. Central Plastics
    - c. Pipeline Seal and Insulator
    - d. F. H. Maloney
    - e. Calpico
- G. Grooved Mechanical Transition Couplings (2" thru 6"):
  - 1. Grooved mechanical coupling rated for 300 psi CWP and 180°F. Consisting of two ductile iron housings, Grade P fluoroelastomer gasket, and bolts and hex nuts zinc electroplated plated, ASTM B-633.

2. Provides a single coupling connection for grooved end stainless steel pipe to grooved end copper tubing of the same nominal size.
3. UL classified in accordance with ANSI / NSF-61 for potable water service.
4. For use only on Types 304 or 316 Schedules 10S and 40S stainless steel pipe, and ASTM B88 Types K, L and M and ASTM B306 Type DWV copper tubing.

### **2.10 COMPRESSED AIR**

- A. Design Pressure: 200 psig (1380 kPa gauge).
- B. Maximum Design Temperature: 130°F (54°C)
- C. Piping - 3" (80 mm) and Under - Type L Copper Braze:
  1. Tubing: Type L hard drawn seamless copper tube, ASTM B819, cleaned and capped "for oxygen service". Tube size indicated is nominal designation.
  2. Joints: BCuP silver braze, AWS A5.8.
  3. Fittings: Wrought copper solder joint, ANSI B16.22, cleaned and bagged for oxygen service.
  4. Joints: Mechanical threaded connection from CMT to CMT or BCuP silver braze, AWS A5.8 transition to Type L copper.
- D. Shutoff Valves - 3" (80 mm) and Under:
  1. VS-2: MSS SP-110, three-piece body, full port, double-seal bolted union ball type, 400 psi (2760 kPa) WOG, bronze body, chrome plated brass ball, blowout proof stem, cleaned, tested, lockable, plugged and tagged at factory for required service, with type L copper tube extensions brazed to flanges. Provide a standard keyed padlock with each valve. Review padlock type with Owner prior to installation.

### **2.11 VACUUM**

- A. Design Pressure: 200 psig (1380 kPa gauge).
- B. Maximum Design Temperature: 130°F (54°C)
- C. Piping - All Sizes:
  1. Tubing: Type K or L hard drawn seamless copper tube, ASTM B819, cleaned and capped "for oxygen service". Tube size indicated is nominal designation.
  2. Joints: BCuP silver braze, AWS A5.8.
  3. Fittings: Wrought copper solder joint, ANSI B16.22, cleaned and bagged for oxygen service.
- D. Shutoff Valves:
  1. VS-2: 4" (100 mm) and under, MSS SP-110, three-piece body, full port, double-seal bolted union ball type, 400 psi (2760 kPa) WOG, bronze body, chrome plated brass ball, blowout proof stem, cleaned, tested, lockable, plugged and tagged at factory for required service, with type K copper tube extensions brazed to flanges. Provide a standard keyed padlock with each valve. Review padlock type with Owner prior to installation.

### **2.12 NITROGEN AIR**

- A. Design Pressure: 300 psig (2070 kPa gauge).
  1. Maximum Design Temperature: 130°F (54°C).
- B. Piping - All Sizes:
  1. Tubing: Type K hard drawn seamless copper tube, ASTM B819, cleaned and capped - for nitrogen service. Tube size indicated is nominal designation.
  2. Joints: BCuP silver braze, AWS A5.8.
  3. Fittings: Wrought copper solder joint, ANSI B16.22, cleaned and bagged "for nitrogen service".
- C. Shutoff Valves:

1. VS-2: 4" (100 mm) and under, MSS SP-110, three-piece body, full port, double-seal bolted union ball type, 400 psi (2760 kPa) WOG, bronze body, chrome plated brass ball, blowout proof stem, cleaned, tested, lockable, plugged and tagged at factory for required service, with type K copper tube extensions brazed to flanges. Provide a standard keyed padlock with each valve. Review padlock type with Owner prior to installation.

### **2.13 HELIUM**

- A. Design Pressure: 300 psig (2070 kPa gauge).
  1. Maximum Design Temperature: 130°F (54°C).
- B. Piping - All Sizes:
  1. Tubing: Type K hard drawn seamless copper tube, ASTM B819, cleaned and capped - for helium service. Tube size indicated is nominal designation.
  2. Joints: BCuP silver braze, AWS A5.8.
  3. Fittings: Wrought copper solder joint, ANSI B16.22, cleaned and bagged "for helium service".
- C. Shutoff Valves:
  1. VS-2: 4" (100 mm) and under, MSS SP-110, three-piece body, full port, double-seal bolted union ball type, 400 psi (2760 kPa) WOG, bronze body, chrome plated brass ball, blowout proof stem, cleaned, tested, lockable, plugged and tagged at factory for required service, with type K copper tube extensions brazed to flanges. Provide a standard keyed padlock with each valve. Review padlock type with Owner prior to installation.
  - 2.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- E. Connect to equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.
- G. Roof Penetration (Vent) Flashing:
  1. Built-up Roofing: Flash vents with 3# seamless sheet lead of sufficient size to extend 15" into roofing felts for built-up roofs.
  2. Membrane, Metal or Shingled Roofs: Flash vents with premolded pipe flashing cones for single-ply membrane roofs, metal roofs, or shingled roofs.
- H. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

### **3.2 SYSTEM, PIPING AND VALVE SCHEDULE**

- A. Cold Water, Hot Water, Tempered Water - Potable and Non-Potable (Above Ground):
  1. Copper Pipe; Type L; Solder Joints: All Sizes
  2. Copper Pipe; Type L; Mechanical Press Connection: 4" and Under
  3. Copper Pipe; Type L; Mechanically Coupled Grooved Joints: 2-1/2" to 8"
  4. Stainless Steel; Schedule 5; Type 316; Mechanical Press Connection: 4" and Under
  5. Stainless Steel; 304; Grooved Joints: 2" through 12"
  6. Galvanized Steel; Standard Weight; Mechanically Coupled Grooved Joints: 6" and Over
  7. Galvanized Steel; Standard Weight; Threaded Joints: 6" and Over
  8. Cross-Linked Polyethylene (PEX); Cold Expansion Joints : 3" and Under

9. Virgin Rigid Chlorinated Polyvinyl Chloride (CPVC); SDR-11; Solvent Weld Joints: 2" and Under
  10. Virgin Rigid Chlorinated Polyvinyl Chloride (CPVC) ;Schedule 80; Solvent Weld Joints: 2-1/2" to 8"
  11. Shutoff Valves: BF-1, BA-1
  12. Throttling Valves: GL-1, GL-2
  13. Check Valves: CK-1, CK-7, CK-14
  14. Strainers: ST-1, ST-3, ST-7
- B. Vacuum (Non-Medical):
1. Copper Pipe; Type L; Solder Joints: All Sizes
  2. Shutoff Valves: BA-1, BA-1A, BA-9, PL-13, PL-15
  3. Throttling Valves: GL-1
  4. Check Valves: CK-1, CK-20
  5. Strainers: ST-1, ST-7
- C. Sanitary Waste and Vent, Gravity (Above Ground):
1. Cast Iron; Standard Weight; Hub and Spigot Joints: All Sizes
  2. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets: 1-1/2" to 15"
  3. Copper Pipe: Type DWV; Solder Joints: 1-1/4" to 4"
  4. Copper Pipe: Type M; Solder Joints: 1-1/4" to 4"
  5. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes
  6. Galvanized Steel; Standard Weight; Threaded Joints: 4" and under
  7. Stainless Steel; Type 304; Hub and Spigot Joint: All Sizes
- D. Sanitary Indirect Drainage (Above Ground):
1. Cast Iron; Standard Weight; Hub and Spigot Joints: All Sizes
  2. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets: 1-1/2" to 15"
  3. Copper Pipe: Type DWV; Solder Joints: 1-1/4" to 4"
  4. Copper Pipe: Type M; Solder Joints: 1-1/4" to 4"
  5. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes
  6. Galvanized Steel; Standard Weight; Threaded Joints: 4" and under
  7. Stainless Steel; Type 304; Hub and Spigot Joint: All Sizes
- E. Sanitary Waste - Pumped (Above Ground - Inside Building):
1. Copper Pipe; Type K; Solder Joints: All Sizes
  2. Copper Pipe; Type K; Mechanical Press Connection: All Sizes
  3. Galvanized Steel; Standard Weight; Threaded Joints: 4" and under
  4. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes
  5. Shutoff Valves: BA-1, BA-1A, BF-1, GA-7
  6. Check Valves: CK-1, CK-13
- F. Acid Waste and Vent:
1. Polypropylene (fire retardant); Schedule 40 Drainage; Electrically Fused Joints: All Sizes
  2. Polypropylene (non-fire retardant); Schedule 40 Drainage; Electrically Fused Joints: All Sizes
  3. Polyvinylidene Fluoride (PVDF); Schedule 40 Drainage; Electrically Fused Joints: All Sizes
  4. Chlorinated Polyvinyl Chloride (CPVC); Schedule 40 Drainage; Solvent Weld Joints: All Sizes
  5. Glass; Tempered; Beaded Ends; Glass Pipe Sleeve Type Joints: All Sizes
  6. Polyvinylidene Fluoride (PVDF); SDR 11; Fusion Weld: 2-1/2" to 12"
- G. Condensate/Equipment Drainage:
1. Cast Iron; Standard Weight; Hub and Spigot Joints: All Sizes
  2. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets: 1-1/2" to 15"
  3. Copper Pipe: Type DWV; Solder Joints: 1-1/4" to 4"
  4. Copper Pipe: Type M; Solder Joints: 1-1/4" to 4"
  5. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes

### 3.3 TESTING PIPING

- A. Sanitary Drainage, Sanitary Vent, Acid Waste, Acid Vent:

1. Test all piping with water to prove tight.
  2. Test piping before insulation is applied.
  3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
  4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
  5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
  6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
  7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.
- B. Hot Water - Potable and Non-Potable, Cold Water - Potable and Non-Potable:
1. Test pipes underground or in chases and walls before piping is concealed.
  2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
  3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen. Exception: Inert gas test shall not be used to test plastic piping.
  4. Hold test pressure for at least 2 hours.
  5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.
- C. All Other Piping:
1. Test piping at 150% of normal operating pressure.
  2. Piping shall hold this pressure for one hour with no drop in pressure.
  3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
  4. Drain and clean all piping after testing is complete.

### 3.4 CLEANING PIPING

- A. Assembly:
1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
  2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.
  3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.
  4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.
- B. Air Blow:
1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.
  2. Air blow applies to the following systems:
    - a. Acetylene
    - b. Carbon Dioxide



- c. Nitrogen (use oil free air or nitrogen gas)
  - d. Argon (use oil free air or nitrogen gas)
  - e. Instrument Air (use oil free air or nitrogen gas)
  - f. Distilled Water (use maximum of 50 psig pressure)
  - g. Chemical Feed
  - h. Air Compressor Intakes
  - i. Sulfuric Acid (use oil free air or nitrogen gas)
- C. All Water Piping:
1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
  2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
  3. If necessary, remove valves to clean out all foreign material.

### 3.5 INSTALLATION

- A. General Gas Installation Requirements:
1. Install all systems in accordance with manufacturer's instructions and the current edition of NFPA 99.
  2. Braze joints in pipe and tubing. DURING BRAZING OF PIPE CONNECTIONS, PURGE INTERIOR OF PIPE CONTINUOUSLY WITH NITROGEN. Make joint without adding flux.
  3. Change pipe size with reducing fittings. Change direction with fittings.
  4. Cut pipe and tubing accurately and install without springing or forcing.
  5. Pitch piping down in direction of flow.
  6. Provide pipe sleeves per Section 22 05 29.
  7. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.
  8. Coordinate utility warning and identification tape with backfill operation and NFPA 99 requirements. Refer to Section 22 05 53 for identification.
  9. Provide identification for all piping. Refer to Section 22 05 53.
  10. Label all valve boxes and area alarm panels with engraved plastic labels indicating area or rooms served. Label service valves with valve tags as listed in Section 22 05 53 and tag listing area served by the valve.
  11. Mount gas outlets and valve boxes, as shown on architectural wall elevations (refer to drawings). In the absence of this information being provided, verify with Project Architect the acceptability of the following mounting heights:
    - a. Gas Outlets: 48 inches (1220 mm) from finished floor to centerline of gas outlet.
    - b. Valve Boxes: 48 inches (1220 mm) from finished floor to top of valve box enclosure.
  12. Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.
    - a. 1/4" (6 mm) pipe or tubing: 60" (1500 mm) OC
    - b. 3/8" (10 mm) pipe or tubing: 72" (1800 mm) OC
    - c. 1/2" (15 mm) pipe or tubing: 72" (1800 mm) OC
    - d. 3/4" (20 mm) pipe or tubing: 84" (2100 mm) OC
    - e. 1" (25 mm) pipe or tubing: 96" (2440 mm) OC
    - f. 1-1/4" (32 mm) pipe or tubing: 108" (2700 mm) OC
    - g. 1-1/2" (40 mm) or larger (horizontal): 120" (3000 mm) OC
    - h. 1-1/2" (40 mm) or larger (vertical): 10' (3000 mm) at every floor not to exceed 15" (4600 mm).
- B. General Installation Requirements:
1. Provide dielectric connections between dissimilar metals.
  2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
  3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

C. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

D. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):

1. All piping in MRI rooms shall be non-ferrous regardless of materials described on Part 2.

E. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.
2. Provide clearance for installation of insulation and access to valves and fittings.
3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.
5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

F. Sanitary and Storm Piping:

1. Install all sanitary and storm piping inside the building with a slope as shown on the drawings.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 2 feet per second.
4. Sway Bracing: Where horizontal sanitary and/or storm pipes 4 inches and larger change flow direction greater than 45°, rigid bracing or thrust restraints shall be installed to resist movement of the upstream pipe in the direction of pipe flow. The rigid bracing or thrust restraint shall be connected to structure. A change of flow direction from horizontal into a vertical pipe does not require the upstream pipe to be braced.
5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
6. Starter fittings with internal baffles are not permitted.

### 3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.
- N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2" limestone.

### **3.7 DRAINING AND VENTING**

- A. Unless otherwise indicated on the drawings, all horizontal water lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- E. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- F. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- G. All vent and drain piping shall be of same materials and construction for the service involved.

### **3.8 PLUMBING VENTS**

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.

- C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.
- D. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.
- E. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- F. In no case shall the vent through the roof be less than 4" in diameter.
- G. Vent pipes through the roof shall be located a minimum of from any air intake opening on the roof.

### **3.9 BRANCH CONNECTIONS**

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:
  - 1. Domestic water piping above ground.
- E. Further limit use of mechanically formed fittings as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Main must be Type K or L copper tubing.
  - 3. Permanent marking shall indicate insertion depth and orientation.
  - 4. Branch pipe shall conform to the inner curve of the piping main.
  - 5. Main must be 1" or larger.
  - 6. Branch must be 3/4" or larger.
- F. Forged weld-on fittings are limited as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Main must be 2-1/2" or larger.
  - 3. Branch line is at least two pipe sizes under main size.

### **3.10 JOINING OF PIPE**

- A. Threaded Joints (Galvanized Steel Pipe):
  - 1. Threads shall conform to ANSI B2.1 "Pipe Threads".
  - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
  - 3. Apply thread lubricant to male threads as follows:
    - a. Vents and Roof Conductors: Red graphite
    - b. All Other Services: Teflon tape
- B. Flanged Joints (Galvanized Steel Pipe):
  - 1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
  - 2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
  - 3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180° apart are torqued in sequence.
  - 4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

- a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
  - b. Maximum pressure rating of at least 250 psig
  - c. Minimum temperature rating: -10°F.
  - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.
- C. Solder Joints (Copper Pipe):
1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
  2. Flux shall be non-acid type.
  3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.
- D. Brazed Joints (Copper Pipe):
1. Make up joints with silver alloy brazing filler metal conforming to ASTM B260 "Brazing Filler Metal" BAg-1 or BAg-2. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply non-corrosive flux of the type recommended by filler alloy manufacturer, evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly using oxygen-acetylene torch with tip size recommended by fitting manufacturer. Wipe and brush joint clean after alloy has set.
  2. Remove discs from solder end valves during brazing.
- E. Welded Joints (Galvanized Steel Pipe):
1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless mandatory local codes take precedence.
  2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.
  3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
  4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
  5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.
- F. Mechanically Coupled Grooved Joints (Copper and Stainless Steel Pipe):
1. Grooved connections shall mechanically engage, lock, and seal the grooved pipe ends in a positive couple. Each coupling shall have malleable iron housing clamps, steel bolts and nuts, and sealing gasket designed so internal pressure increases the tightness of the seal. Couplings must be installation-ready style for quick installation and no more than two-piece housings.
  2. All work, including pipe grooving, shall be accomplished in accordance with manufacturer's published instructions.
  3. All fittings shall be provided by one manufacturer. Mixing grooved components are not acceptable.
  4. Product Warranty:

- a. Standard: One-year product warranty. A factory-trained manufacturer's representative shall visit the site for contractor training and installation observation.
    - 1) On-site Training: Manufacturer's factory trained representative shall provide training of contractor™™s field personnel in use of grooving tools and installation of product. Documentation of installing contractor training with manufacturer™™s representative shall be submitted to the Architect/Engineer.
    - 2) Job Site Visitation: Manufacturer's representative shall periodically visit job site to ensure manufacturer™™s installation practices are being followed.
  - b. Extended 5-Year Product Warranty: Manufacturer shall provide extended 5-year warranty to replace product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.
  - c. Extended 5-Year Product and Installation Warranty: Manufacturer shall provide extended 5-year warranty to replace product and any part of the system damaged as a direct result of a failure of the product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.
- G. Mechanical Press Connection (Copper and Stainless Steel Pipe):
1. Copper press fitting shall be made in accordance with the manufacturer's installation instructions.
  2. Fully insert tubing into the fitting and mark tubing.
  3. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.
  4. Joint shall be pressed with a tool approved by the manufacturer.
  5. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.
- H. Mechanical Push-To-Connect (Stainless Steel Pipe):
1. Push-to-connect fittings shall be made in accordance with the manufacturer's installation instructions.
  2. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.
- I. Mechanical Joints (Ductile Iron Pipe):
1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.
  2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
- J. Push-On Joints - Pressure Pipe (Ductile Iron, PVC Pressure):
1. Joints shall be single gasket type conforming to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to 5°. Plain spigot ends shall be suitably beveled for easy entry into bell, centering in gasket and compression of gasket.
  2. The joint shall be liquid tight under all pressures from vacuum to 350 psig.
  3. Furnish sufficient lubricant for a thin coat on each spigot end. Lubricant shall be non-toxic, impart no taste or odor to conveyed liquid, and have no deleterious effect on the rubber gasket. Lubricant shall be of such consistency that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.
  4. Assemble per manufacturer's installation instructions.

- K. Hub and Spigot Joints - Sanitary Pipe and Storm Pipe (Cast Iron and Stainless Steel Pipe):
  - 1. Lead and Oakum Joints: Pack joint with oakum made of vegetable fiber, cotton, or hemp. Pour joint with molten lead up to top of hub. Ensure leak-free joints by working joint with inside and outside caulking irons.
  - 2. Compression Gasket Joints: Joint shall be one-piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.
- L. Solvent Weld Joints (PVC):
  - 1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.
- M. Solvent Weld Joints (CPVC):
  - 1. Make joints with a one-step process. Use CPVC cement conforming to ASTM F493. A primer is not required.
  - 2. If a primer is required by the Authority Having Jurisdiction, then a primer conforming to ASTM F656 shall be used.
- N. Electrically Fused Joints (Acid Waste and Acid Vent ):
  - 1. Fused joints shall be made in accordance with manufacturer's installation instructions.
  - 2. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
  - 3. Follow the manufacturer's cold weather installation procedures.
- O. No-Hub Sleeve Gaskets (No-Hub) (Cast Iron Pipe):
  - 1. Gasket shall be heavy weight class, conforming to ASTM C564.
  - 2. The gasket shall have an internal center stop.
  - 3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
  - 4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

### **3.11 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfection of the domestic water piping shall be completed within three (3) weeks prior to building occupancy. Contractor is responsible for disinfecting water piping if used by workers during construction; disinfection during construction does not eliminate the requirement for final disinfection prior to occupancy. Flushing of piping shall be completed within two (2) weeks prior to building occupancy.
- B. Provide necessary connections at the start of individual sections of mains for adding chlorine.
- C. Before starting work, verify system is complete, flushed and clean.
- D. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- E. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- F. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.
- G. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.
- H. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.
- I. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.

- J. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

**3.12 SERVICE CONNECTIONS**

- A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

**END OF SECTION**



**SECTION 22 40 00  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. All plumbing fixtures.

**1.2 REFERENCES**

- A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI A112.19.2M - Vitreous China Plumbing Fixtures.
- E. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- F. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- G. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
- H. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
- I. AHRI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- J. ASSE 1002 - Water Closet Flush Tank Ball Cocks.
- K. Americans with Disabilities Act (ADA), Title III.
- L. The Energy Policy Act (EPA) of 2005.

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.
- B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.
- D. Manufacturer shall provide special seismic certification per HCAI CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. All fixtures shall be as scheduled on the drawings.
- B. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General Installation Requirements:
  - 1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
  - 2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
  - 3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.
  - 4. Install components level and plumb.
  - 5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
  - 6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
  - 7. Refer to architectural drawings for fixture mounting heights.
  - 8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

- B. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:
  - 1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
  - 2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
  - 3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.
  - 4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.
- C. ADA Accessible Exposed Sink and Lavatory Trim:
  - 1. All exposed sink and lavatory traps, piping and angle stops installed at accessible sink and lavatory locations shall include offset style drain tailpiece, p-trap installed near and parallel with back wall, and insulation kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

**3.2 ADJUSTING AND CLEANING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

**3.3 FIXTURE ROUGH-IN SCHEDULE**

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

**END OF SECTION**

**SECTION 23 05 00**  
**BASIC HVAC REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

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

**1.2 SCOPE OF WORK**

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Scope of Work:
  - 1. Plumbing Work: Refer to Section 22 05 00 "Basic Plumbing Requirements".
  - 2. Heating Work shall include, but is not necessarily limited to:
    - a. Extend existing heating water system including , piping, insulation, air control equipment, terminal heating equipment, and specialties. Make final connections to all coils, including those furnished by others.
    - b. Extend existing condenser water system including pumps, piping, insulation, and specialties.
    - c. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
    - d. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.
    - e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
    - f. Complete all applicable tests, certifications, forms, and matrices.
  - 3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
    - a. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
    - b. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
    - c. Furnish and install all terminal air boxes and reheat coils.
    - d. Furnish and install complete fume hood exhaust systems including fans, ductwork, and fittings.
    - e. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
    - f. Furnish and install all temperature control systems.
    - g. Furnish and install all fire dampers.
    - h. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.
    - i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
    - j. Complete all applicable tests, certifications, forms, and matrices.
  - 4. Temperature Control Work shall include, but is not necessarily limited to:
    - a. Furnish and install a complete temperature control system as specified in Section 23 09 00.
    - b. Furnish automatic control valves and dampers for installation by others.
    - c. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

- d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
5. Fire Protection Work: Refer to Section 21 05 00 "Basic Fire Suppression Requirements".
6. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
  - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
  - b. Complete all applicable tests, certifications, forms, and matrices

### **1.3 OWNER FURNISHED PRODUCTS**

- A. The Owner will supply the following items for installation and/or connection by this Contractor:
  1. Fume Hood.
  2. Laboratory equipment
- B. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- C. This Contractor shall make all mechanical system connections shown on the drawings or as required for fully functional units.
- D. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

### **1.4 WORK SEQUENCE**

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

### **1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL CONTROL CONTRACTORS**

- A. Definitions:
  1. "Mechanical Contractors" refers to the following:
    - a. Plumbing Contractor.
    - b. Heating Contractor.
    - c. Air Conditioning and Ventilating Contractor.
    - d. Temperature Control Contractor.
    - e. Fire Protection Contractor.
    - f. Testing, Adjusting, and Balancing Contractor.
  2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
  3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
  4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
  5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
    - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

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

B. General:

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

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
  - a. Boiler Feed Pumps.
  - b. Burners.
  - c. Chillers.
  - d. Computer Room Air Conditioning Units.
  - e. Condensate Return Stations.
  - f. Condensing Units.

- g. Makeup Air Units.
    - h. Electric Humidifiers.
    - i. Gas Trains.
    - j. Package Air Handling Units.
    - k. Packaged Rooftop Units.
  2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
  3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
  4. Temperature Control Subcontractor's Responsibility:
    - a. Wiring of all devices needed to make the Temperature Control System functional.
    - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
    - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
  5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.
- D. Electrical Contractor's Responsibility:
  1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
  2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
  3. Provides motor control and temperature control wiring, where so noted on the drawings.
  4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
  5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
  6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

#### **1.6 SUBMITTALS**

- A. Submittals shall be required as indicated in Division 1 and Division 23 specification sections.
- B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:
  1. Transmittal: Each transmittal shall include the following:
    - a. Date
    - b. Project title and number
    - c. Contractor's name and address
    - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
    - e. Description of items submitted and relevant specification number
    - f. Notations of deviations from the contract documents
    - g. Other pertinent data
  2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
    - a. Date
    - b. Project title and number
    - c. Architect/Engineer

- d. Contractor and subcontractors' names and addresses
  - e. Supplier and manufacturer's names and addresses
  - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
  - g. Description of item submitted (using project nomenclature) and relevant specification number
  - h. Notations of deviations from the contract documents
  - i. Other pertinent data
  - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
  - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
  - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
  - b. Unstamped submittals will be rejected.
  - c. The Contractor's review shall include, but not be limited to, verification of the following:
    - 1) Only approved manufacturers are used.
    - 2) Addenda items have been incorporated.
    - 3) Catalog numbers and options match those specified.
    - 4) Performance data matches that specified.
    - 5) Electrical characteristics and loads match those specified.
    - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
    - 7) Dimensions and service clearances are suitable for the intended location.
    - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
    - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature

- applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
  8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
  9. Reproduction of contract documents alone is not acceptable for submittals.
  10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
  11. Submittals not required by the contract documents may be returned without review.
  12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
  13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
  14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
  15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
    - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
  16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    - a. Submittal file name: 23 XX XX.description.YYYYMMDD
    - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
  5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
- D. Paper Copy Submittal Procedures:
1. Paper copies are acceptable where electronic copies are not provided.
  2. The Contractor shall submit ten (10) paper copies of each shop drawing.
  3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

## 1.7 EQUIPMENT SUPPLIERS INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation



and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Computer Room Units
  2. Seismic Restraints and Equipment Bracing
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

#### **1.8 PRODUCT DELIVERY, STORAGE, HANDLING MAINTENANCE**

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

#### **1.9 NETWORK INTERNET CONNECTED EQUIPMENT**

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

#### **1.10 WARRANTY**

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

#### **1.11 INSURANCE**

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

#### **1.12 MATERIAL SUBSTITUTION**

- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other

contractors.

- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

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

**PART 3 - EXECUTION**

**3.1 JOBSITE SAFETY**

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

**3.2 ARCHITECT ENGINEER OBSERVATION OF WORK**

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
  - 1. Placing fill over underground and underslab utilities.
  - 2. Covering exterior walls, interior partitions and chases.
  - 3. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
  - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
    - a. Pipe insulation is installed and fully sealed.
    - b. Pipe and duct wall penetrations are sealed.
    - c. Pipe identification and valve tags are installed.
    - d. Main, branch and flexible ducts are installed.
    - e. Diffusers, registers and grilles are installed and connected to ductwork.
    - f. Terminal air box reheat coil piping or wiring is complete.
    - g. Terminal air box control wiring is complete and all control boxes are closed.
  - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
  - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

**3.3 PROJECT CLOSEOUT**

- A. The following paragraphs supplement the requirements of Division 01.
- B. Final Jobsite Observation:

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

### **3.4 OPERATION AND MAINTENANCE MANUALS**

- A. General:
1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    - a. O&M file name: O&M.div23.contractor.YYYYMMDD
    - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
  5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
  6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
  7. All text shall be searchable.
  8. Bookmarks shall be used, dividing information first by specification section, then

systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

9. Once the electronic version of the manuals has been approved by the Architect/Engineer, Insert paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.
8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.
10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

**3.5 SYSTEM STARTING AND ADJUSTING**

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.
- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

### **3.6 RECORD DOCUMENTS**

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- D. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.
- E. Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.
- F. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- G. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- H. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

### **3.7 PAINTING**

- A. This Contractor shall paint the following items:
  - 1. All piping in mechanical room
  - 2. Piping exposed in kitchen
- B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer the color preference and furnish this color.

- F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- H. Paint all outdoor exposed natural gas piping the color selected by Owner or Architect/Engineer.
- I. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
  - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
  - 2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.
  - 3. Color of paint shall be as follows:
    - a. All piping in mechanical room:
      - 1) Chilled Water: Blue pipe/black letters
      - 2) Condenser Water: Green pipe/black letters
      - 3) Heating Water: Orange pipe/black letters
      - 4) Natural Gas: Yellow pipe/black letters
    - b. Piping exposed in kitchen:
      - 1) All Piping: White

### **3.8 ADJUST AND CLEAN**

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

### **3.9 SPECIAL REQUIREMENTS**

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

### **3.10 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION**

- A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.
- B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.
- C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.

- D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.
- E. The following steps shall be taken during testing, adjusting, and balancing of each air system:
  - 1. All construction activities in all spaces served by the air system shall stop.
  - 2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
  - 3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.
  - 4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.
- F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

**END OF SECTION**





**SECTION 23 05 05  
HVAC DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

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

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

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

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

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

**3.2 PREPARATION**

- A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

**3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK**

- A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned ducts and piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes and ducts, including abandoned pipes and ducts above accessible ceilings. Cut ducts flush with walls and floors, cap duct that remains, and patch surfaces. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- H. Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 6" of the last branch. End caps shall be 3" pressure class and seal class "A".

- I. Extend existing installations using materials and methods compatible with existing installations, or as specified.
- J. Properly reclaim and dispose of all refrigerant in demolished equipment and as required for extension of existing equipment.

**3.4 CUTTING AND PATCHING**

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 23 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes X-ray or similar non-destructive means.
- F. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

**3.5 CLEANING AND REPAIR**

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

**3.6 SPECIAL REQUIREMENTS**

- A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.
- B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

**END OF SECTION**

**SECTION 23 05 13  
MOTORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Single Phase and Three Phase Electric Motors.

**1.2 REFERENCES**

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

**1.3 DELIVERY, STORAGE, AND HANDLING**

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

**1.4 OPERATION AND MAINTENANCE DATA**

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

**PART 2 - PRODUCTS**

**2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS**

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

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

- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.
- G. Each contractor shall set all motors furnished by him.
- H. All motors shall have a minimum service factor of 1.15.
- I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- J. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.

- K. Aluminum end housings are not permitted on motors 15 HP or larger.
- L. Motor Driven Equipment:
  - 1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
  - 2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.
- M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.
- N. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.

**2.2 ELECTRICALLY COMMUTATED MOTORS (ECM)**

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

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

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

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7

40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

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

## 2.4 MOTORS FOR HAZARDOUS DUTY

A. Where noted for hazardous duty, motors shall be designed for the class, group, and T code listed for the application. Frame sizes 143T and larger shall have normally closed winding thermostats to keep surface temperatures below the nameplate T code under all conditions.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

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

**END OF SECTION**



**SECTION 23 05 29  
HVAC SUPPORTS AND ANCHORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Flashing and Sealing of Equipment and Pipe Stacks.

**1.2 REFERENCES**

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

**1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

**PART 2 - PRODUCTS**

**2.1 SEISMIC RESTRAINTS**

- A. Refer to Section 23 05 50 for additional requirements for seismic restraints.

**2.2 HANGER RODS**

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2-1/2" and smaller	3/8"	3/8"
3" through 3-5/8"	3/8"	3/8"
4" and 5"	1/2"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel pipe.

Column #2: Copper, plastic and fiberglass reinforced pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

**2.3 PIPE AND STRUCTURAL SUPPORTS**

**A. General:**

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

**B. Vertical Supports:**

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

a. Products:

- 1) Eaton Fig B3373 Series
  - 2) nVent 510 Series
  - 3) Anvil Fig. 90
  2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.
    - a. Products:
      - 1) Mason RBA, RCA or RDA
      - 2) Mason BR
  3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.
    - a. Products:
      - 1) Pipeshields E100
  4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
  5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- C. Hangers and Clamps:
1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
  2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65°F to +275°F.
  3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
  4. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
    - a. Products:
      - 1) Anvil Fig. 160, 161, 162, 163, 164, 165
      - 2) Eaton Fig. 3160, 3161, 3162, 3163, 3164, 3165
      - 3) nVent Model 630, 631, 632, 633, 634, 635
  5. Unless otherwise indicated, hangers shall be as follows:
    - a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and Smaller:
      - 1) Products: Bare Steel, Plastic or Insulated Pipe:
        - a) Anvil Fig. 260
        - b) Eaton Fig. 3100
        - c) nVent Model 400
      - 2) Products: Bare Copper Pipe:
        - a) Eaton Fig. B3104F or B3100CTC
        - b) Anvil Fig. CT65
        - c) nVent Fig. 402
    - b. Roller Type: Service: Insulated Hot Pipe - 4 inches and Larger:
      - 1) Products: 4" through 6":
        - a) Anvil Fig. 181, 271
        - b) Eaton Fig. 3110



- c) nVent Model 610
    - 2) Products: 8" and Above:
      - a) Anvil Fig. 171, 271
      - b) Eaton Fig. 3114, 3117
      - c) nVent Model 605
  - c. Continuous Channel with Clevis Type: Service: Plastic Tubing, Flexible Hose, Soft Copper Tubing:
    - 1) Products:
      - a) Eaton Fig. B3106, with Fig. B3106V
      - b) nVent Model 104, with Model 104V
      - c) Anvil Fig. 1V
  - d. Adjustable Swivel Ring Type: Service: Bare Metal Pipe - 4 inches and Smaller:
    - 1) Products: Bare Steel Pipe:
      - a) Anvil Fig. 69
      - b) Eaton Fig. B3170NF
      - c) nVent Model FCN
    - 2) Products: Bare Copper Pipe:
      - a) Eaton Fig. B3170CTC
      - b) nVent 102A0 Series
      - c) Anvil Fig. CT-69
- 6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
  - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
  - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
- 7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
  - a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller:
    - 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp.
    - 2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
    - 3) Products: Bare Steel, Plastic or Insulated Pipe:
      - a) Unistrut Fig. P1100 or P2500
      - b) Eaton Fig. B2000 or B2400
      - c) Anvil Fig. AS1200
      - d) nVent USC
    - 4) Products: Bare Copper Pipe:
      - a) Eaton Fig. BVT
      - b) nVent CADDY Cushion Clamp
  - b. Roller Type: Service: Insulated Hot Pipe - 4 inches and larger:
    - 1) Products: 4" through 6":

- a) Unistrut Fig. P2474
  - b) Eaton Fig. B218
  - c) Anvil Fig. ROL-12
  - d) nVent ROL12
  - 2) Products: 8" and Above:
    - a) Unistrut Fig. P2474-1
    - b) Eaton Fig. B219
    - c) nVent Fig. ROL-13
    - d) Anvil AS1902
- D. Upper (Structural) Attachments:
- 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
    - a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):
      - 1) Products:
        - a) Anvil Fig. 86
        - b) Eaton Fig. B3033/B3034
        - c) nVent Model 300 & 310
    - b. Scissor Type Beam Clamps (for use with bar-joists and wide flange):
      - 1) Products:
        - a) Anvil Fig. 228, 292
        - b) Eaton Fig. B3054
        - c) nVent Model 360
    - c. Centrally Loaded Open Web Joist Hangers (for use with bar joists):
      - 1) Products:
        - a) MCL. M1, M2 or M3
    - d. Concrete: Inserts Single Rod Galvanized:
      - 1) Products:
        - a) Anvil Fig. 282
        - b) Eaton Fig. B3014
        - c) nVent Model 355
    - e. Concrete: Inserts Continuous Strip Galvanized:
      - 1) Products:
        - a) Unistrut Corp P3200 Series
        - b) Eaton Fig. B22
        - c) nVent CONB
        - d) Anvil AS249
    - f. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
    - g. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
    - h. Steel Structure Welding:

- 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

#### **2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS**

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.
- F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150°F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

#### **2.5 ROOF PENETRATIONS**

- A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe and duct penetrations. Refer to drawings for details.
- B. Conical Pipe Boot: Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color: White shall match roofing material.
- C. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

#### **2.6 SLEEVES AND LINTELS**

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
  - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
  - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120°F, sleeves may be thermoplastic with integral water seal and textured surface.
  - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
  - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
  - 5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
T	High/Low Temperature (Steam)	Silicone	-67°F to 400°F
T	Fire Seals (1 hour)	Silicone	-67°F to 400°F
FS	Fire Seals (3 hours)	Silicone	-67°F to 400°F
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

- 6. Manufacturers:
  - a. Thunderline Corporation "Link-Seals"
  - b. O-Z/Gedney Company
  - c. Calpico, Inc.
  - d. Innerlynx
  - e. Metraflex Company (cold service only)

**2.7 ESCUTCHEON PLATES AND TRIM**

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

**2.8 PIPE PENETRATIONS**

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

**2.9 PIPE ANCHORS**

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

**2.10 FINISH**

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

**PART 3 - EXECUTION**

**3.1 HVAC SUPPORTS AND ANCHORS**

- A. General Installation Requirements:
  - 1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
  3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
  4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
  2. Set all concrete inserts in place before pouring concrete.
  3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
  4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
  5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- C. Pipe Requirements:
1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
  2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
  3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
  4. Piping shall not introduce strains or distortion to connected equipment.
  5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
  6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
  7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
  8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
  2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
    - a. The hanger is attached within 6" from a web/chord joint.
    - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
  3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
  4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
  - 1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" & under: 7'-0"
      - 2) 1-1/2": 9'-0"
      - 3) 2": 10'-0"
      - 4) 2-1/2": 11'-0"
      - 5) 3": 12'-0"
      - 6) 4" & larger: 12'-0"
  - 2. Steel (Std. Weight or Heavier - Vapor Service):
    - a. Maximum Spacing:
      - 1) 1-1/4" and under: 9'-0"
      - 2) 1-1/2": 12'-0"
      - 3) 2" & larger: 12'-0"
  - 3. Hard Drawn Copper & Brass (Liquid Service):
    - a. Maximum Spacing:
      - 1) 3/4" and under: 5'-0"
      - 2) 1": 6'-0"
      - 3) 1-1/4": 7'-0"
      - 4) 1-1/2": 8'-0"
      - 5) 2": 8'-0"
      - 6) 2-1/2": 9'-0"
      - 7) 3": 10'-0"
      - 8) 4": 12'-0"
      - 9) 6": 12'-0"
  - 4. Hard Drawn Copper & Brass (Vapor Service):
    - a. Maximum Spacing:
      - 1) 3/4" & under: 7'-0"
      - 2) 1": 8'-0"
      - 3) 1-1/4": 9'-0"
      - 4) 1-1/2": 10'-0"
      - 5) 2": 11'-0"
      - 6) 2-1/2" & larger: 12'-0"
  - 5. Plastic Pipe:
    - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
  - 6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
    - a. Continuous channel with hangers maximum 8'-0" OC.
- I. Installation of hangers shall conform to MSS SP-58, 69, and 89.

**END OF SECTION**

**SECTION 23 05 48**  
**HVAC VIBRATION ISOLATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Vibration Isolation.
- B. Flexible Connectors.

**1.2 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.
- B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.
- C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.
- D. Isolator submittals shall include:
  - 1. Equipment served
  - 2. Type of Isolator
  - 3. Load in Pounds per Isolator
  - 4. Recommended Maximum Load for Isolator
  - 5. Spring Constants of Isolators (for Spring Isolators)
  - 6. Load vs. Deflection Curves (for Neoprene Isolators)
  - 7. Specified Deflection
  - 8. Deflection to Solid (at least 150% of calculated deflection)
  - 9. Loaded (Operating) Deflection
  - 10. Free Height
  - 11. Loaded Height
  - 12. Kx/Ky (horizontal to vertical stiffness ratio - for spring isolators)
  - 13. Materials and Coatings
  - 14. Spring Diameters
- E. Make separate calculations for each isolator on equipment where the load is not equally distributed.
- F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.
- G. Submit certification that equipment, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Submit calculations by a licensed Structural Engineer substantiating that equipment mountings and foundations, and their seismic restraints, can meet the required external forces "G" load for all rigidly and resiliently supported equipment without failure and permanent displacement. Submit similar calculations for life safety equipment restraints for "G" loading. Restrain all resiliently mounted piping with cable seismic bracing per HCAI series OPM pre-approval.

**PART 2 - PRODUCTS**

**2.1 BASIC CONSTRUCTION AND REQUIREMENT**

- A. Vibration isolation for this project is subject to seismic restraint requirements of Section 23 05 50.
- B. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

- C. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection (e.g., 3" for 2" calculated deflection). The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.
- D. The lateral to vertical stiffness ratio ( $K_x/K_y$ ) of spring isolators shall be between 0.8 and 2.0.
- E. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
- F. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.
- G. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.
- H. Provide motor slide rails for belt-driven equipment per Section 23 05 13.
- I. All isolators, except M1, shall have provision for leveling.

## 2.2 MOUNTINGS

- A. Type M1:
  - 1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35".
  - 2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.
  - 3. Manufacturers:
    - a. Mason "Super W"
    - b. Kinetics "NGS"
    - c. VMC/Amber-Booth "SPNR"
    - d. Vibration Eliminator Co. "400N"
- B. Type M2:
  - 1. Double deflection neoprene with minimum static deflection of 0.15" at calculated load and 0.35" at maximum rated load.
    - a. All metal shall be neoprene covered. Mounting shall have friction pads both top and bottom.
  - 2. All units shall have bolt holes and be bolted down.
  - 3. Use steel rails above the mountings to compensate for the overhang of equipment such as small vent sets and close coupled pumps.
  - 4. Manufacturers:
    - a. Mason Industries "ND" or "DNR"
    - b. VMC/Amber-Booth "RVD"
    - c. Kinetics "RD"
    - d. Vibration Mountings and Controls "RD"
    - e. Vibration Eliminator Co. "T22" or "T44"
- C. Type M3:
  - 1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.
  - 2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.



3. All mountings shall have leveling bolts.
  4. Manufacturers:
    - a. Mason "SLFH"
    - b. Kinetics "FDS"
    - c. VMC/Amber-Booth SW-3 4"
    - d. Vibration Eliminator Co. "OST"
- D. Type M4:
1. Use restrained spring mountings for equipment with operating weight different from the installed weight such as chillers and boilers, and equipment exposed to the wind such as cooling towers.
  2. Spring isolators shall be free-standing with 1/4" neoprene acoustical friction pads.
  3. All units shall have bolt holes and be bolted down. Prevent short circuiting with neoprene bushings and washers between bolts and isolators.
  4. All mountings shall have leveling bolts.
  5. Housings with vertical resilient limit stops shall prevent spring extension when weight is removed. Housings shall serve as blocking during erection and the installed and operating heights shall be the same.
  6. Maintain a minimum clearance of 1/2" around restraining bolts and between the housings and the springs so as not to interfere with the spring action.
  7. Limit stops shall be out of contact during normal operation.
  8. Select isolators for equipment subjected to wind loads in conformance with ASCE 7-02.
  9. Manufacturers:
    - a. Mason "SLRS"
    - b. Kinetics "FLS"
    - c. Aeroflex "AWRS"
    - d. Vibration Eliminator Co. "KW"

## 2.3 THRUST RESTRAINTS

- A. Type TR1:
1. Horizontal thrust restraints shall consist of spring elements in neoprene cups with grommets to prevent short circuiting hanger rods and nuts and washers for pre-compression.
  2. Select springs for deflection of 0.75" to 1.50" at maximum calculated thrust. Springs shall be field adjusted for 1/2" movement. Spring constant may not exceed 50% of the vertical stiffness of the mounts (M3, etc.).
  3. Centrifugal fans shall incline slightly forward when off and discharge directly in line with the ductwork at maximum static pressure.
  4. Fabricate structural supports as needed to attach thrust restraints.
  5. If connected to a housing, check maximum thrust the housing can restrain and connections required.
  6. Manufacturers:
    - a. Mason "WB" or "PC30"
    - b. Kinetics
    - c. Vibration Eliminator Co. "HTR-1"

## 2.4 HANGERS

- A. Type H1:
1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
  2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.
  3. Provide hangers with end connections as required for hanging ductwork or piping.
  4. Manufacturers:
    - a. Mason "HD"
    - b. Kinetics "RH"
    - c. Aeroflex "RHD"
    - d. Vibration Eliminator Co. "IC/3C/3CTD"

- e. Vibro Acoustics "RH"
- B. Type H2:
  - 1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.
  - 2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
  - 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the grommet and short circuiting the spring.
  - 4. Provide end connections for hanging ductwork or piping.
  - 5. Manufacturers:
    - a. Mason "30"
    - b. Kinetics "SRH"
    - c. VMC/Amber-Booth "BSRA"
    - d. Aeroflex "RSH"
    - e. Vibration Eliminator Co. "SNC"
    - f. Vibro Acoustics "SH/SHC"
- C. Type H3:
  - 1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.
  - 2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
  - 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the grommet and short circuiting the spring.
  - 4. Provide end connections for hanging ductwork or piping.
  - 5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.
  - 6. Deflection shall be indicated by a pointer and scale.
  - 7. Manufacturer:
    - a. Mason "30N"
    - b. Kinetics "SFH"
    - c. VMC/Amber-Booth "BSW"
    - d. Vibration Eliminator Co. "SNRC"
    - e. Vibro Acoustics "SHR"

## 2.5 BASES

- A. Type B1:
  - 1. Rectangular structural steel bases.
  - 2. All perimeter members shall be beams or channels with minimum depth of 10% of the longest base dimension or 14" maximum if rigidity is acceptable to the equipment manufacturer.
  - 3. Use height saving brackets, unless noted otherwise.
  - 4. Manufacturers:
    - a. Mason "WF"
    - b. Kinetics "SBB"
    - c. Aeroflex
    - d. Vibration Eliminator Co. "AF"
- B. Type B2:
  - 1. Steel members welded to height-saving brackets to cradle machines having legs or bases that do not require complete supplementary bases.
  - 2. Members shall be sufficiently rigid to prevent strains in the equipment.
  - 3. Manufacturers:
    - a. Mason "ICS"
    - b. Kinetics "SFB"
    - c. Aeroflex

- C. Type B3:
1. Rectangular structural channel concrete forms for floating foundations.
  2. Where applicable, bases shall be large enough to support suction elbows, discharge elbows, and suction diffusers.
  3. Channel depth shall be at least 1/12 the longest dimension of the base but not less than 6". Depth need not exceed 12" if rigidity is acceptable to equipment manufacturer.
  4. Forms shall include 1/2" rebars welded on 6" centers running both ways in a layer 1-1/2" above the bottom, and drilled steel members with sleeves welded below the holes to receive the equipment anchor bolts.
  5. Contractor shall pour 3,300 PSI concrete inside entire base. Concrete to be same thickness as sides of base. Trowel concrete smooth on top of base.
  6. Use height saving brackets, unless noted otherwise.
  7. Manufacturers:
    - a. Mason "K"
    - b. Kinetics "CIB-H"
    - c. Aeroflex "MPF"
    - d. VMC/Amber-Booth "CPF"
    - e. Bulldog, Inc.
    - f. Vibration Eliminator Co. "SN".

## 2.6 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

- A. Type FC1:
1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.
  2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.
  3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.
  4. Connectors up to 2" size may have threaded ends.
  5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.
  6. All connectors shall be rated for a minimum working pressure of 150 psi at 200°F.
  7. Manufacturer:
    - a. Metraflex "Double Cable-Sphere"
    - b. Minnesota Flex Corp.
    - c. Mercer "200 Series"
    - d. Twin City Hose "MS2".
- B. Type FC2:
1. Stainless steel flexible connectors with corrugated stainless steel hose body and stainless steel braided casing.
  2. Rated for minimum working pressures of 150 psi at 70°F and 100 psi at 800°F .
  3. Sizes 2" and under shall have steel threaded connections.
  4. Sizes 2-1/2" and over shall have 150 lb. steel flanges.
  5. Suitable for 1/2" permanent misalignment.
  6. Manufacturers:
    - a. Mason or Mercer "BSS-GU"
    - b. Metraflex "ML"
    - c. Twin City Hose "TCHS"
    - d. American "BOA B4-1"
    - e. Flexible Metal Hose Company "FM-21"
    - f. or Wheatley.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Provide vibration isolation as indicated on the drawings and as described herein.

- C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.
- D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.
- E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.
- F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

### **3.2 PIPE ISOLATION**

- A. The first three hangers from vibration-isolated equipment shall be type H1.
- B. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.
- C. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.
- D. Support piping to prevent extension of flexible connectors.

**END OF SECTION**

**SECTION 23 05 50  
SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Seismic Requirements.

**1.2 QUALITY ASSURANCE**

- A. General:
  - 1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.
  - 2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.
  - 3. These requirements are beyond those listed in Section 23 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.
- B. Manufacturer:
  - 1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.
  - 2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.
- C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.
- D. Installer: Company specializing in performing the work of this Section.

**1.3 REFERENCES**

- A. International Building Code, 2021.
- B. ASHRAE - A Practical Guide to Seismic Restraint.
- C. Technical Manual 5-809-10, NAVFAC P-355, Air Force Manual 88-3, Chapter 13.
- D. ASCE 7-02, Chapter 9.
- E. ASCE 7-05, Chapter 13.
- F. ASCE 7-10, Chapter 13.
- G. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
- H. NFPA 13 - Installation of Sprinkler Systems.
- I. NFPA 14 - Standpipe and Hose Systems.

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 23 05 00.
- B. Submittal to Code Official
  - 1. Contractor shall submit copies of the seismic shop drawings to the governing code authority for approval.
- C. Shop Drawings:
  - 1. Calculations, restraint selections, and installation details shall be designed and sealed by a Structural Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.
  - 2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.
  - 3. Manufacturer's Certifications: Structural Engineer licensed in the state where the project is located shall review and approve manufacturer's certifications of compliance.
  - 4. System Supports/Restraints - Submit for each condition requiring seismic bracing:
    - a. Calculations for each seismic brace and detail utilized on the project.
    - b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.

- c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.
  - d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.
5. Equipment - Submit for each piece of equipment supplied:
- a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.
  - b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.
  - c. Engineering calculations and details for equipment anchorage and support structure.
- D. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

#### **1.5 TESTING AND INSPECTION**

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.
- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

#### **1.7 DESIGN REQUIREMENTS**

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. Forces shall be calculated with the above requirements and Equation 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

#### **1.8 COORDINATION**

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

## 1.9 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

## PART 2 - PRODUCTS

### 2.1 SUPPLIERS

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
  1. B-Line Systems, Inc. (800) 851-7415, [www.b-line.com](http://www.b-line.com).
  2. Unistrut Corporation <http://www.unistrut.us/>
  3. Kinetics Noise Control (877) 457-2695, [www.kineticsnoise.com](http://www.kineticsnoise.com).
  4. Mason Industries, Inc. [www.mason-ind.com](http://www.mason-ind.com).
  5. Loos & Co., Inc. (800) 321-5667, [www.loosnaples.com](http://www.loosnaples.com).
  6. Tolco (909) 737-5599, [www.tolco.com](http://www.tolco.com)
  7. ISAT 877.523.6060, [www.isatsb.com](http://www.isatsb.com)
  8. Vibro-Acoustics (416) 291-7371 , <https://virs.vibro-acoustics.com/>

### 2.2 SEISMIC DESIGN CRITERIA

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions
  1. Stay in Place:
    - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.
  2. Remain Operational:
    - a. Requirements for "Stay in Place" listed above shall be met.
    - b. The following systems and associated equipment are intended not to fail externally or internally and are intended to continue operation following a seismic event:
      - 1) Heating
      - 2) Cooling
      - 3) Air Handling
      - 4) Exhaust

### 2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
  1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
  2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
  3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
  4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
  5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.
- C. Housekeeping Pads:
  1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

### 2.4 MATERIALS

- A. Use the following materials for restraints:
  1. Indoor Dry Locations: Steel, zinc plated.

2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

## **2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS**

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
  1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

## **2.6 SEISMIC BRACING COMPONENTS**

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
  1. Materials for Channel: ASTM A 1011, GR 33.
  2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
  3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
  4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
  1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
  2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.
- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.



- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.
- U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.
- V. Brace all terminal units with water coils as required by the building code and provide flexible connection to the coil if bracing is required.
- W. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.
- X. Do not brace a system to two different structures such as a wall and a ceiling.
- Y. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- Z. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- AA. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- BB. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

### **3.2 SEISMIC RESTRAINT EXCLUSIONS**

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

## **END OF SECTION**



**SECTION 23 05 53  
HVAC IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Identification of products installed under Division 23.

**1.2 REFERENCES**

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM B-1, B-3, and B-8 for copper conductors.
- C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 - 2kV Cables.
- D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
- E. NFPA-99 - Health Care Facilities.
- F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. 3M
- B. Bunting
- C. Calpico
- D. Craftmark
- E. Emedco
- F. Kolbi Industries
- G. Seton
- H. W.H. Brady
- I. Marking Services.

**2.2 MATERIALS**

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
- H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

- I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
- J. Maintenance Access Doors:
  - 1. Doors and roof hatches used to access equipment serving hazardous ductwork systems shall be provided with a minimum 4" x 6" ANSI Z535.2 biohazard warning label. Label shall read "WARNING - BIOHAZARD. ONLY AUTHORIZED PERSONNEL BEYOND THIS POINT".
  - 2. Coordinate location of warning label with Owner.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
  - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
  - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
  - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
  - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
  - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
  - 6. Number all tags and show the service of the pipe.
- D. Pipe Markers:
  - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
  - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
  - 3. Stencil Painted Pipe Markers:
    - a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
    - b. Apply primer on non-insulated pipes before painting.
    - c. Use background and letter colors as scheduled later in this section.
  - 4. Apply markers and arrows in the following locations where clearly visible:
    - a. At each valve.
    - b. On both sides of walls that pipes penetrate.
    - c. At least every 20 feet along all pipes.
    - d. On each riser and each leg of each "T" joint.
    - e. At least once in every room and each story traversed.
  - 5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.
- E. Equipment:
  - 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
  - 2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

**3.2 SCHEDULE**

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:

1. HEATING WATER SUPPLY: White lettering; green background
2. HEATING WATER RETURN: White lettering; green background
3. CHILLED WATER SUPPLY: White lettering; green background
4. CHILLED WATER RETURN: White lettering; green background
5. CONDENSER WATER SUPPLY: White lettering; green background
6. CONDENSER WATER RETURN: White lettering; green background
7. CONDENSATE DRAIN: White lettering; green background
8. COMPRESSED AIR: White lettering; green background
9. NATURAL GAS: Black lettering; yellow background
10. VACUUM - 15-30 IN. HG: Black lettering; white background
11. INSTRUMENT AIR - 160-185 PSI: White lettering; black background
12. NITROGEN - 160-185 PSI : White lettering; black background
13. OXYGEN - 50-55 PSI: White lettering; green background

B. Ductwork and Fan Systems: All fans, filters housings, and access doors shall be labeled with text as follows:

1. WARNING - CHEMICAL FUME EXHAUST: Black lettering; orange/white background

**END OF SECTION**



**SECTION 23 05 93**  
**TESTING, ADJUSTING, AND BALANCING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of heating systems.
- C. Testing, adjusting, and balancing of cooling systems.
- D. Measurement of final operating condition of HVAC systems.

**1.2 QUALITY ASSURANCE**

- A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.
- B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

**1.3 REFERENCES**

- A. AABC - National Standards for Total System Balance, Seventh Edition.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing (latest edition).
- H. TABB - International Standards for Environmental Systems Balance.

**1.4 REPORT FORMS**

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

**1.5 WARRANTY/GUARANTEE**

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

**1.6 SCHEDULING**

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

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

**PART 3 - EXECUTION**

**3.1 GENERAL REQUIREMENTS**

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.
- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.
- H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

**3.2 EXAMINATION**

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
  - 1. General Equipment Requirements:
    - a. Equipment is safe to operate and in normal condition.
    - b. Equipment with moving parts is properly lubricated.
    - c. Temperature control systems are complete and operable.
    - d. Proper thermal overload protection is in place for electrical equipment.
    - e. Direction of rotation of all fans and pumps is correct.
    - f. Access doors are closed and end caps are in place.
  - 2. Duct System Requirements:
    - a. All filters are clean and in place. If required, install temporary media.
    - b. Duct systems are clean and free of debris.
    - c. Fire/smoke and manual volume dampers are in place, functional and open.
    - d. Air outlets are installed and connected.
    - e. Duct system leakage has been minimized.
  - 3. Pipe System Requirements:
    - a. Coil fins have been cleaned and combed.
    - b. Hydronic systems have been cleaned, filled, and vented.
    - c. Strainer screens are clean and in place.
    - d. Shutoff, throttling and balancing valves are open.
- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

**3.3 PREPARATION**

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.



### 3.4 INSTALLATION TOLERANCES

- A.  $\pm 10\%$  of scheduled values:
  - 1. Adjust air inlets and outlets to  $\pm 10\%$  of scheduled values.
  - 2. Adjust piping systems to  $\pm 10\%$  of design values.
- B.  $\pm 5\%$  of scheduled values:
  - 1. Adjust fume exhaust systems to  $\pm 5\%$  of scheduled values.
  - 2. Adjust supply and exhaust air-handling systems for space pressurization to  $\pm 5\%$  of scheduled values, and to provide proper pressurization.
- C.  $+ 5\%$  of scheduled values
  - 1. Adjust outdoor air intakes to within  $+ 5\%$  of scheduled values.
  - 2. Adjust exhaust air through energy recovery equipment to within  $+5\%$  of scheduled values.
- D. Adjust supply, return, and exhaust air-handling systems to  $+10\% / -5\%$  of scheduled values.

### 3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

### 3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

## PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

### 4.1 GENERAL REQUIREMENTS

- A. Title Page:
  - 1. Project name.
  - 2. Project location.
  - 3. Project Architect.
  - 4. Project Engineer (IMEG Corp.).
  - 5. Project General Contractor.
  - 6. TAB Company name, address, phone number.
  - 7. TAB Supervisor's name and certification number.
  - 8. TAB Supervisor's signature and date.
  - 9. Report date.
- B. Report Index
- C. General Information:
  - 1. Test conditions.
  - 2. Nomenclature used throughout report.
  - 3. Notable system characteristics/discrepancies from design.
  - 4. Test standards followed.
  - 5. Any deficiencies noted.
  - 6. Quality assurance statement.
- D. Instrument List:
  - 1. Instrument.
  - 2. Manufacturer, model, and serial number.
  - 3. Range.
  - 4. Calibration date.

### 4.2 AIR SYSTEMS

- A. Air Moving Equipment:
  - 1. General Requirements:

- a. Drawing symbol.
  - b. Location.
  - c. Manufacturer, model, arrangement, class, discharge.
  - d. Fan RPM.
  - e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
  - f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
    - a. Supply flow rate (cfm): specified and actual.
    - b. Return flow rate (cfm): specified and actual.
    - c. Outside flow rate (cfm): specified and actual.
    - d. Exhaust flow rate (cfm): specified and actual.
  3. Pressure Drop and Pressure:
    - a. Filter pressure drop: specified and actual.
    - b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
    - c. Inlet pressure.
    - d. Discharge pressure.
- B. Fan Data:
1. Drawing symbol.
  2. Location.
  3. Manufacturer and model.
  4. Flow rate (cfm): specified and actual.
  5. Total static pressure: specified and actual. (Indicate measurement locations).
  6. Inlet pressure.
  7. Discharge pressure.
  8. Fan RPM.
- C. Electric Motors:
1. Drawing symbol of equipment served.
  2. Manufacturer, Model, Frame.
  3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
  4. Measured: Amps in each phase.
- D. Air Terminal (Inlet or Outlet):
1. Drawing symbol.
  2. Room number/location.
  3. Terminal type and size.
  4. Velocity: specified and actual.
  5. Flow rate (cfm): specified and actual.
  6. Percent of design flow rate.
- E. Air Terminal Unit (Terminal Air Box) Data:
1. General Requirements:
    - a. Drawing symbol.
    - b. Location.
    - c. Manufacturer and model.
    - d. Size.
    - e. Type: constant, variable, single, dual duct.
  2. Flow Rate:
    - a. Cooling maximum flow rate (cfm): specified and actual.
    - b. Heating maximum flow rate (cfm): specified and actual.
    - c. Minimum flow rate (cfm): specified and actual.
    - d. Water flow rate (gpm): specified and actual with system performance adjusted as follows:
      - 1) Adjust heating water system pump to maintain maximum system differential pressure.
      - 2) Set calibrated balance valve fully open.
      - 3) Command terminal air box control valve to fully open.

- 4) Measure heating coil flow using calibrated balance valve.
  - 5) Note: Commanding terminal air box control valve to be fully open shall be done on a valve-by-valve basis. Do not command all control valves to be fully open at the same time, as the heating water system may not have sufficient capacity.
  - 6) Note: After Balancing of all terminal air boxes is complete, release the heating water pump to automatically reset the system DP based on control valve position per sequence of operation requirements.
3. Temperature:
    - a. Entering air temperature: specified and actual.
    - b. Leaving air temperature (in minimum airflow/heating mode): specified and actual.
    - c. Entering water temperature: specified and actual.
    - d. Leaving water temperature: specified and actual.
  4. Pressure Drop and Pressure:
    - a. Inlet static pressure during testing cooling maximum airflow rate (maximum and minimum).
    - b. Water pressure drop: specified and actual.
- F. Fume Hood:
1. Drawing symbol.
  2. Location.
  3. Manufacturer and Model.
  4. Total flow rate (cfm): specified and actual.
  5. Test velocities.
  6. Hood opening dimensions.

#### 4.3 HEATING SYSTEMS

- A. Heating Coils:
1. General Requirements:
    - a. Drawing symbol.
    - b. Service.
    - c. Location.
    - d. Manufacturer and model.
    - e. Size.
  2. Flow Rate:
    - a. Flow rate (cfm): specified and actual.
    - b. Water flow rate: specified and actual.
  3. Temperature:
    - a. Entering air temperature: specified and actual.
    - b. Leaving air temperature: specified and actual.
    - c. Entering water temperature: specified and actual.
    - d. Leaving water temperature: specified and actual.
  4. Pressure Drop and Pressure:
    - a. Air pressure drop: specified and actual.
    - b. Steam pressure after valve: specified and actual.
    - c. Water pressure drop: specified and actual.
- B. Terminal Heat Transfer Units:
1. General Requirement:
    - a. Drawing symbol.
    - b. Location.
    - c. Manufacturer and model.
    - d. Include air data only for forced air units.
  2. Flow Rate:
    - a. Flow rate (cfm): specified and actual.
    - b. Water flow rate (cfm): specified and actual.
  3. Temperature:
    - a. Entering air temperature: specified and actual.

- b. Leaving air temperature: specified and actual.
- c. Entering water temperature: specified and actual.
- d. Leaving water temperature: specified and actual.

#### 4.4 COOLING SYSTEMS

- A. Electric Motors:
  - 1. Drawing symbol of equipment served.
  - 2. Manufacturer, Model, Frame.
  - 3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
  - 4. Measured: Amps for each phase.
- B. Heat Exchangers (not all items apply to all units):
  - 1. General Requirements:
    - a. Drawing symbol.
    - b. Service.
    - c. Location.
    - d. Manufacturer and model.
  - 2. Primary Heat Exchanger:
    - a. Primary water entering temperature: specified and actual.
    - b. Primary water leaving temperature: specified and actual.
    - c. Primary water flow: specified and actual.
    - d. Primary water pressure drop: specified and actual.
    - e. Primary water Btuh (gpm x temperature drop x 500).
  - 3. Secondary Heat Exchanger:
    - a. Secondary water entering temperature: specified and actual.
    - b. Secondary water leaving temperature: specified and actual.
    - c. Secondary water flow: specified and actual.
    - d. Secondary water pressure drop: specified and actual.
    - e. Secondary water Btuh (gpm x temperature rise x 500).
- C. Cooling Coils:
  - 1. General Requirements:
    - a. Drawing symbol.
    - b. Service.
    - c. Location.
    - d. Size.
    - e. Manufacturer and model.
  - 2. Temperature:
    - a. Entering air DB temperature: specified and actual.
    - b. Entering air WB temperature: specified and actual.
    - c. Leaving air DB temperature: specified and actual.
    - d. Leaving air WB temperature: specified and actual.
    - e. Entering water temperature: specified and actual.
    - f. Leaving water temperature: specified and actual.
  - 3. Flow Rate:
    - a. Flow rate (cfm): specified and actual.
    - b. Water flow rate (gpm): specified and actual.
  - 4. Pressure Drop and Pressure:
    - a. Water pressure drop: specified and actual.
    - b. Air pressure drop: specified and actual.
- D. Terminal Heat Transfer Units:
  - 1. General Requirements:
    - a. Drawing symbol.
    - b. Location.
    - c. Manufacturer and model.
    - d. Include air data only for forced air units.
  - 2. Temperature:
    - a. Entering air DB temperature: specified and actual.
    - b. Leaving air DB temperature: specified and actual.

- c. Entering water temperature: specified and actual.
- d. Leaving water temperature: specified and actual.
- 3. Flow rate:
  - a. Flow rate (cfm): specified and actual.
  - b. Water flow (gpm): specified and actual.

**END OF SECTION**



**SECTION 23 07 13  
DUCTWORK INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Ductwork Insulation.
- B. Insulation Jackets.

**1.2 QUALITY ASSURANCE**

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials:
  - 1. Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
  - 2. Fungal Resistance: No growth when tested in accordance with ASTM G21 (antifungal test).
  - 3. Rated velocity on coated air side for air erosion in accordance with UL 181 at 5,000 fpm minimum.
  - 4. UL listed in Category HNKT.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.
- F. ASTM E814 - Fire Tests of Through Penetrations Firestops.
- G. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- J. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- K. NFPA 255 - Surface Burning Characteristics of Building Materials.
- L. UL - XHEZ - Through Penetration Firestop Systems.
- M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
- N. UL 263 - Full Scale External Fire Tests with Hose Stream.
- O. UL 723 - Surface Burning Characteristics of Building Materials.
- P. UL 1479 - Fire Tests of Through Penetrations Firestops.

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and location.
- B. Submit manufacturer's installation instructions.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75°F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.
- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim Kraft facing, 3 lb./cu. ft. density.

TYPE	K-FACTOR	R-VALUE PER THICKNESS							
		THICKNESS	0.5	1	1.5	2	2.5	3	4
Flexible Fiberglass Outside Wrap	0.28			5.4	7.1	8.9	10.7	14.3	17.9
Semi-Rigid Fiberglass Board Wrap	0.25			6.0	8.0	10.0	12.0	16.0	20.0
Flexible Fiberglass Liner	0.28	1.8	3.6	5.4	7.1	8.9	10.7	14.3	17.9
Rigid fiberglass liner	0.23		4.3	6.5	8.7	10.9	13.0	17.4	21.7
Double Wall Ductwork	0.27		3.7	5.6	7.4	9.3	11.1	14.8	18.5
Flexible High Temp Rigid Preformed Fiberglass Acoustical Liner	0.23		4.3	6.5	8.7	10.9	13.0	17.4	21.7

**2.2 JACKETS**

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- E. Exterior Duct Wrap - Flexible, Type A:
  - 1. Apply with edges tightly butted.
  - 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
  - 3. Seal joints with adhesive backed tape.
  - 4. Apply so insulation conforms uniformly and firmly to duct.
  - 5. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.
  - 6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
  - 7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
  - 8. Staples may be used, but must be covered with tape.
  - 9. Vapor barrier must be continuous.
  - 10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.
- F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):
  - 1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
  - 2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.



3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
  4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.
  - G. Continue insulation with vapor barrier through penetrations unless code prohibits.
  - H. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.
- 3.2 SCHEDULE**
- A. Refer to Section 23 31 00 for scheduling of insulation.

**END OF SECTION**



**SECTION 23 07 19  
HVAC PIPING INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Piping Insulation.
- B. Insulation Jackets.

**1.2 QUALITY ASSURANCE**

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

**1.3 REFERENCES**

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- D. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.
- J. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- K. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- L. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- M. ASTM E84 - Surface Burning Characteristics of Building Materials.
- N. NFPA 255 - Surface Burning Characteristics of Building Materials.
- O. UL 723 - Surface Burning Characteristics of Building Materials.
- P. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

**PART 2 - PRODUCTS**

**2.1 INSULATION**

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
- B. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.29 maximum 'K' value at 75°F; density 7.3lb/ft; minimum compressive strength 90 psi parallel to rise; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose polymer or polypropylene service jacket for above grade installations.

- C. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.
- D. Type H: Semi-Rigid Mineral Wool Fiberboard; ANSI/ASTM C612; 0.30 maximum 'K' value at 200°F. Suitable to 1200°F.
- E. Type I: Rigid Mineral Fiber Blocks; ANSI/ASTM C612; 0.625 maximum 'K' value at 800°F. Suitable for 1900°F.

## **2.2 VAPOR BARRIER JACKETS**

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.
- B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

### **3.2 INSTALLATION**

- A. General Installation Requirements:
  - 1. Install materials per manufacturer's instructions, building codes and industry standards.
  - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
  - 3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
  - 4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.
- B. Insulated Piping Operating Below 60°F:
  - 1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
  - 2. All balance valves and strainers with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
  - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Insulated Piping Operating Above 140°F:
  - 1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
  - 2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

### 3.3 SUPPORT PROTECTION

- A. Provide a shield on all insulated piping at each support between the insulation jacket and the support.
- B. On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:
  1. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
    - a. Molded hydrous calcium silicate (only use for pipes with operating temperatures above 90°F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
    - b. As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
      - 1) Products:
        - a) Buckaroo CoolDry
        - b) Cooper/B-Line Fig. B3380 through B3384
        - c) Pipe Shields A1000, A2000
    - c. Insulation Couplings:
      - 1) Molded thermoplastic slip coupling, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
      - 2) Horizontal Strut Mounted Insulated Pipe Manufacturers:
        - a) Klo-Shure or equal
      - 3) Vertical Manufacturers:
        - a) Manufacturers: Klo-Shure Titan or equal
    - d. Rectangular blocks, plugs, or wood material are not acceptable.
    - e. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.
  - C. Neatly finish insulation at supports, protrusions, and interruptions.
  - D. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
  - E. Shields shall be at least the following lengths and gauges:

<u>Pipe Size</u>	<u>Shield Size</u>
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge
5" to 6"	18" long x 16 gauge
8" to 14"	24" long x 14 gauge
16" to 24"	24" long x 12 gauge

- F. Ferrous hot piping 4 inches and larger, provide steel saddle at rollers as described in Section 23 05 29 "HVAC Supports and Anchors".
- G. Minimum 1/4" rolled galvanized steel plates shall be provided in addition to the sleeves as reinforcement on large pipes to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength. Refer to section above for exact locations.

**3.4 INSULATION**

- A. Type A Insulation:
  - 1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
  - 2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
  - 3. Apply insulation with laps on top of pipe.
  - 4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.
- B. Type C Insulation:
  - 1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
  - 2. Insulate fittings with prefabricated fittings.
- C. Type D Insulation:
  - 1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
  - 2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.
- D. Type H, I, and J Insulation:
  - 1. Apply with edges tightly butted, joints broken.
  - 2. Secure with 16 gauge galvanized, annealed steel wire or 1/2" x 0.015" galvanized steel bands, 12" maximum centers.
  - 3. Install welding studs, clips and angles where required to anchor wires and bands.

**3.5 SCHEDULE**

- A. Refer to drawings for insulation schedule.

**END OF SECTION**

**SECTION 23 09 00  
CONTROLS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Control Devices, Components, Wiring and Material.
- B. Instructions for Owners.
- C. Remodeling.

**1.2 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.
- B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.
- C. Technician: Minimum five years' experience installing commercial temperature control systems.
- D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 100 miles of the job site.

**1.3 REFERENCES**

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- F. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- G. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

**1.4 SUBMITTALS**

- A. Equipment Coordination:
  - 1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
  - 2. Control valve selections shall be based on flow rates shown in approved shop drawings.
  - 3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.
- B. Shop Drawings:
  - 1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.
  - 2. Cross-reference all control components and point names in a single table located at the beginning of the submittal with the identical nomenclature used in this section.
  - 3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.
  - 4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.
  - 5. Diagrams shall include:
    - a. Wiring diagrams and layouts for each control panel showing all termination numbers.

- b. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
  - c. Identification of all control components connected to emergency power.
  - d. Schematic diagrams for all field sensors and controllers.
  - e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
  - f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.
  - g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.
  - h. All installation details and any other details required to demonstrate that the system will function properly.
  - i. All interface requirements with other systems.
6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.
  7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.
  8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.
  9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:
    - a. Damper Identification Tag.
    - b. Location.
    - c. Damper Type.
    - d. Damper Size.
    - e. Duct Size.
    - f. Arrangement.
    - g. Blade Type.
    - h. Velocity.
    - i. Pressure Drop.
    - j. Fail Position.
    - k. Actuator Identification Tag.
    - l. Actuator Type.
    - m. Mounting.



10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:
  - a. Valve Identification Tag.
  - b. Location.
  - c. Valve Type.
  - d. Valve Size.
  - e. Pipe Size.
  - f. Configuration.
  - g. Flow Characteristics.
  - h. Capacity.
  - i. Valve CV.
  - j. Design Pressure Drop.
  - k. Pressure Drop at Design Flow.
  - l. Fail Position.
  - m. Close-off Pressure.
  - n. Valve and Actuator Model Number and Type.
11. Indoor modular air handling units (Section 23 73 13) and mixed flow return air fans (Section 23 34 13) provided under this project will have piezometer type sensors mounted at fan inlets by fan manufacturer. Fan manufacturer will provide fan specific flow coefficients and equations that can be used to calculate fan airflow based on measured pressure differential at fan inlet. TCC shall provide the following:
  - a. Quantity of pressure transducers so that each individual fan is served by a dedicated pressure transducer. Each pressure transducer shall have a range that is selected based on scheduled maximum airflow for each fan. TCC shall submit a schedule that shows the following calculations for each fan/pressure transducer:
    - 1) Pressure drop at maximum scheduled airflow for each fan using fan manufacturer's flow coefficient.
    - 2) Recommended transducer range.
  - b. Pneumatic tubing as required to interconnect all piezometer type sensors and pressure transducer. Note: Where UV lamps are installed upstream of supply fan inlets, only copper tubing shall be used.
  - c. Fasteners and supports as required to securely attached tubing, pressure transducers, conduits, wiring, and the like for a complete installation.
12. Airflow Measuring Station Schedule:
  - a. The manufacturer's authorized representative shall prepare the airflow measuring station submittal, or review and approve in writing the submittal prepared by the TCC prior to submission to the Architect/Engineer and prior to installation. The representative shall review air handling equipment submittals and duct fabrication drawings to ensure that all AFMS locations meet the appropriate parameters to achieve proper installation and the specified accuracy. Comply with all manufacturer's installation requirements including straight up and downstream duct lengths. Install airflow straighteners if required by the manufacturer based on installation constraints. The Architect/Engineer shall be notified for approval of any deviations.
  - b. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.
  - c. Submit installation, operation, and maintenance documentation.

13. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
  14. Provide PICS files indicating the BACnet functionality and configuration of each device.
  15. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements if problems are found during BTL testing is required.
  16. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.
  17. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.
  18. Clearly identify work by others in the submittal.
  19. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.
- C. Operation and Maintenance Manual:
1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.
  2. Provide three complete sets of manuals.
  3. Each O&M manual shall include:
    - a. Table of contents with indexed tabs dividing information as outlined below.
    - b. Definitions: List of all abbreviations and technical terms with definitions.
    - c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.
    - d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.
    - e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.
    - f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.
    - g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
    - h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.

- i. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.
    - j. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.
  - D. Training Manual:
    - 1. Provide a course outline and training manuals for each training class.
  - E. Record Documents:
    - 1. Submit record documentation per Section 23 05 00.
    - 2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings as AutoCAD~~çç~~ or Visio~~çç~~ compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.
    - 3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.
    - 4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.
    - 5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the A/E verifying completion and proper operation of all points.
- 1.5 DELIVERY, STORAGE AND HANDLING**
  - A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
  - B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.
- 1.6 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**
  - A. Control Valves.
  - B. Flow Switches.
  - C. Temperature Sensor Sockets.
  - D. Gauge Taps.
  - E. Automatic Dampers.
  - F. Flow Meters.
- 1.7 AGENCY AND CODE APPROVALS**
  - A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.
    - 1. UL-916; Energy Management Systems.
    - 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."
    - 3. EMC Directive 89/336/EEC (European CE Mark).
    - 4. FCC, Part 15, Subpart J, Class A Computing Devices.
- 1.8 ACRONYMS**
  - A. Acronyms used in this specification are as follows:
    - 1. B-AAC BACnet Advanced Application Controller
    - 2. B-ASC BACnet Application Specific Controller
    - 3. BTL BACnet Testing Laboratories
    - 4. DDC Direct Digital Controls
    - 5. FMCS Facility Management and Control System
    - 6. GUI Graphic User Interface
    - 7. IBC Interoperable BACnet Controller
    - 8. IDC Interoperable Digital Controller

9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

#### **1.9 SUMMARY**

- A. Extend Existing System:
  1. Extend the existing FMCS for this project.
  2. All controllers and accessories shall interface with the existing FMCS.
- B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.
- C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.
- D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

#### **1.10 JOB CONDITIONS**

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

#### **1.11 WARRANTY**

- A. Refer to Section 23 05 00 for warranty requirements.
- B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.
- C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.
- D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

#### **1.12 WARRANTY ACCESS**

- A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. BACnet Protocol:
  1. Johnson Controls: Metasys Extended Architecture

#### **2.2 TERMINAL AIR BOX (TAB) CONTROLLERS**

- A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. and shall be accurate down to 0.004" velocity pressure. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.

- B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.
- C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.
- D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator's terminal connected to the specific controller.
- E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.
- F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

### 2.3 CONTROL DAMPERS

- A. Rectangular Control Dampers - Standard Construction:
  - 1. Shall be licensed to bear the AMCA Certified Rating Seal.
  - 2. Test leakage and pressure drop per AMCA 500.
  - 3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.
  - 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).
  - 5. Shaft: Non-cylindrical, solid aluminum or zinc plated steel with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
  - 6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
  - 7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.
  - 8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
  - 9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
  - 10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
  - 11. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
  - 12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8,000 cfm through a 24" x 24" damper (2000 fpm).
  - 13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8,000 cfm through a 24" x 24" damper (2000 fpm).
- B. Thermally Insulated Control Damper:
  - 1. Shall be licensed to bear the AMCA Certified Rating Seal.
  - 2. Test leakage and pressure drop per AMCA 500.
  - 3. Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness.
  - 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).

5. Shaft: Non-cylindrical, solid aluminum or zinc plated steel shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
  6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
  7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
  8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
  9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
  10. Maximum Leakage: Class 1A at 1" w.c. pressure differential for a 24" x 24" damper.
  11. Maximum Pressure Drop: 0.21" for 8,000 cfm through a 24" x 24" damper (2000 fpm).
- C. Round Galvanized Steel Control Dampers:
1. Test leakage and pressure drop per AMCA 500.
  2. Frame: Minimum 20 gauge galvanized steel, 10" long.
  3. Bearings: Provide thrust bearings for vertical damper applications.
  4. Blades: Two-layer galvanized steel, equivalent 14 gauge thickness with neoprene or polyethylene foam seal enclosed in two-piece blade construction up to 24", 10 gauge steel over 24".
  5. Linkage: Stainless steel, minimum 1/2" diameter shaft through 24", 3/4" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
  6. Maximum Leakage: 8 cfm maximum at 1" w.c. pressure differential for a 24" x 24" damper.
  7. Maximum Pressure Drop: 0.10" for 6,280 cfm through a 24" damper (2,000 fpm).
- D. Round Stainless Steel Control Dampers:
1. Test leakage and pressure drop per AMCA 500.
  2. Frame: Hat-shaped channel, minimum 10 gauge Type 304 stainless steel (304L or 316L for welded duct). Caulk or weld seams to prevent leakage.
  3. Bearings: Provide thrust bearings for vertical damper applications.
  4. Blades: Minimum 12 gauge Type 304 stainless steel construction. No seals are required.
  5. Linkage: Stainless steel, minimum 1/2" diameter shaft through 12", 3/4" shaft through 24", 1" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
  6. Maximum Leakage: 26 cfm maximum at 1" w.c. pressure differential for a 24" x 24" damper.
  7. Maximum Pressure Drop: 0.15" for 6,280 cfm through a 24" damper (2,000 fpm).

## 2.4 DAMPER ACTUATORS

- A. Damper Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Dampers: Where shown on the drawings or sequences, fail-safe mechanism shall operate the damper to the fail position following power interruption.
  - a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
  - b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0 to 100% in 10 percent increments with a 2 second operational delay.
5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.
6. Damper End Switches: Where shown on the drawings or sequences, provide end switches to prove damper reaches open/closed position.

## 2.5 HYDRONIC CONTROL VALVES

### A. General:

1. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 1 psi.
2. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 4 to 5 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 4 psi.
3. Modulating two-way valves shall have equal percentage flow characteristics.
4. Modulating three-way valves shall have linear flow characteristics.
5. Piping geometry correction factors for Cv ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

### B. Two-position:

1. Ball 2" and under:
  - a. Design Pressure: 400 psi
    - 1) Design Temperature: 212°F
    - 2) Design Flow Differential Pressure Rating: 150 psi
  - b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, EPDM, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470°F melting point of 95-5 solder).

### C. Modulating:

1. Globe 1/2" to 2":
  - a. Design Pressure: ANSI Class 250
    - 1) Design Temperature: 280°F
    - 2) Design Flow Differential Pressure Rating: 35 psi
    - 3) Leakage: ANSI Class VI
  - b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel or bronze seat; EPDM, PTFE or RTFE packing; threaded ends.
2. Ball 2" and under:
  - a. Design Pressure: 400 psi
    - 1) Design Temperature: 250°F
    - 2) Design Flow Differential Pressure Rating: 35 psi
    - 3) Leakage: 0%

- b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, EPDM, PTFE or RTFE seats and seals, PTFE characterizing disc, screwed ends.

## 2.6 VALVE ACTUATORS

### A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.
2. Provide visual position indication.
3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

### B. Valve Actuators - Electronic:

1. Actuator shall be UL 873 or 60730 listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation. Mount actuator by means of a V-bolt dual nut clamp with a V-shaped toothed cradle, directly couple and mount to the valve bonnet stem, or ISO-style direct-coupled mounting pad. Actuators shall be capable of being mechanically and electrically paralleled to increase torque, if required.
2. Actuators shall be warranted for a period of five (5) years from the date of production, with the first two (2) years unconditional.
3. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
4. Fail-Safe Valves: Where shown on the drawings or sequences, fail-safe mechanism shall operate the valve to the fail position following power interruption.
  - a. Mechanical/Spring: Mechanical spring return mechanism to drive controlled drive to an end position (open or close) on loss of power.
  - b. Electronic: Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the capacitors. The power fail position shall be proportionally adjustable between 0 to 100% in 10 percent increments with a 2 second operational delay.
5. Feedback: Where shown on drawings or sequences, provide analog feedback signal for positive position indication.

## 2.7 CONTROL INSTRUMENTATION

### A. Temperature Measuring Devices:

1. Electric Thermostats:
  - a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5°F, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.
  - b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5°F, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

### B. Temperature Sensors:

1. Room Temperature Sensor:
  - a. Sensor Only: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range,  $\pm\pm 0.50^\circ\text{F}$  accuracy, no setpoint adjustment or override button.
  - b. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range,  $\pm\pm 0.50^\circ\text{F}$  accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a single warmer/cooler or red/blue visual scale), no override button.



- c. Sensor with Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range,  $\pm\pm 0.50^\circ\text{F}$  accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.
        - d. Sensor with Setpoint Adjustment and Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range,  $\pm\pm 0.50^\circ\text{F}$  accuracy, with exposed single setpoint adjustment (no numeric temperature scale - provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.
  - 2. Duct Temperature Sensor:
    - a. RTD type averaging sensor. 1000 ohm platinum RTD; accuracy: minimum  $\pm 1.2^\circ\text{F}$ ; range  $-40^\circ\text{F}$ - $220^\circ\text{F}$ .
    - b. Sensing element shall have a minimum of 1 foot of sensor length for each 2 square feet of duct or coil area. Sensor shall be arranged evenly across the duct or coil such that no point in the duct or coil is more than 1 foot away from the sensor.
    - c. Probe type thermistors are acceptable in VAV box duct applications downstream of reheat coils.
  - 3. Water Temperature Sensor:
    - a. RTD type. 1000 ohm platinum RTD; accuracy: minimum  $\pm 0.65^\circ\text{F}$ ; range  $-40^\circ\text{F}$ - $220^\circ\text{F}$ .
    - b. Thermowell: RTD must be installed within a 316 stainless steel thermowell using a non-hardening heat conducting paste. Thermowell shall be rated for a minimum static pressure of 500 psig at the maximum operating temperature and be capable of withstanding water velocities of up to 27 fps. The sensor shall be mounted so that it extends into the flow stream to a minimum of 1/3 of the diameter of the pipe. For pipes greater than 10 inch diameter, thermowell shall be installed in a position 45 degrees from the bottom of the pipe. Separate thermometers, as specified elsewhere, shall be installed within 2 feet of each temperature sensor.
- C. Humidity Measuring Devices:
- 1. Humidity Sensors:
    - a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH humidity at temperatures from 50°F to 104°F.
  - 2. Humidistats:
    - a. Room Humidistats: Wall-mounted, proportioning type, with adjustable 2% RH throttling range, operating range from 30% to 80% at temperatures up to 110°F, cover with concealed setpoint. Accuracy shall be minimum of 1.5 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH at temperatures from 50°F to 104°F.
    - b. Duct Humidistats: Proportioning insertion type, with adjustable 2% RH throttling range and operating range from 20% to 80% at temperatures up to 150°F. Accuracy shall be minimum of 1.5 %RH accuracy from 0-90 %RH and 2.5 %RH accuracy from 90-100 %RH at temperatures from 50°F to 104°F.
    - c. High Limit Duct Humidistat: 2-position insertion type, with differential maximum 2% RH.
- D. Combination Room Temperature/Humidity Sensors:
- 1. Wall-mounted two-piece construction, plastic enclosure, off-white color with temperature and humidity measurement, exposed single setpoint adjustment and occupant override. Large display with temperature and %RH readout display, occupied/unoccupied override button with LED, and membrane keypad and gasketing for wipe-down cleaning.

2. Temperature Component: Thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range,  $\pm\pm 0.50^\circ\text{F}$  accuracy.
  3. Humidity Component: Proportioning type, with adjustable 2% RH throttling range, operating range from 0% to 90% at temperatures up to 110°F. Accuracy shall be minimum of 2.0 %RH accuracy from 0-90 %RH.
- E. Pressure Measuring Devices
1. Differential Pressure Switches:
    - a. Standard Pressure Switches:
      - 1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
      - 2) Accuracy shall be  $\pm\pm 3\%$  of full scale maximum throughout entire range at 70°F.
      - 3) Provide mounting brackets, probes, and shutoff valves required for proper installation.
      - 4) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.
      - 5) Provide latching relays that require manual reset once activated.
      - 6) Acceptable Manufacturer: Dwyer Photohelic Series 3000.
    - b. High Pressure Switches (Manual Reset):
      - 1) Differential pressure switch with single pole, double-throw snap switch and enclosure.
      - 2) Rated for pressure specified in sequence of control.
      - 3) Electrical rating shall be 15 amps at 120-480 volts.
      - 4) Setpoint adjustment shall be screw type located inside enclosure.
      - 5) Provide optional manual reset for overpressure protection with all tubing, brackets, and adapters.
      - 6) Repeatability:  $\pm\pm 3\%$ .
  2. Pressure Transmitters/Transducer:
    - a. Air-to-Air:
      - 1) Provide transducer having the following minimum performance for measuring duct static pressure for VFD control or measuring differential pressure across filter banks:
        - a) Accuracy:  $\pm\pm 1.0\%$  FS
        - b) Non-Linearity, BFSL:  $\pm\pm 0.96\%$  FS
        - c) Hysteresis: 0.10% full scale
        - d) Non-Repeatability: 0.05% full scale
        - e) Thermal Effects (compensated range): 0°F to +150°F
        - f) Maximum Line Pressure: 10 PSI
        - g) Zero/Span Shift: 0.033%FS/°F
        - h) Long Term Stability: 0.5%FS/1year
      - 2) Provide transducer with the following minimum performance for measuring differential pressure across piezometer fan inlet airflow measuring stations:
        - a) Unit shall come factory equipped with static tube attached.
        - b) Unit shall include: (1) LCD shall display differential pressure on face of sensor enclosure over the entire operational range, and (2) IPCC-rated polycarbonate enclosure with short circuit proof outputs and reverse polarity protected inputs.
        - c) Accuracy at 72°F:  $\pm\pm 0.25\%$  FS
        - d) Stability:  $\pm\pm 0.25\%$  full scale per year
        - e) Temperature Error: (1) Zero:  $\pm\pm 0.025\%$  full scale per °C, (2) Span: Maximum  $\pm\pm 0.03\%$  full scale per °C
        - f) Environmental Operating Range: 32°F to 140°F.

- g) Overpressure: Proof: (1) 2 psi, (2) Burst: 3 psi
  - h) Humidity: 0% to 95% RH non-condensing.
  - b. Wet-to-Wet (uses include measuring hydronic system differential pressure for VFD control):
    - 1) Unidirectional pressure range selected for appropriate range based on the application.
    - 2) Provide transducer with minimum 250 psi high side proof pressure and minimum 60 psi low side proof pressure.
    - 3) Case shall be constructed of stainless steel/aluminum and shall be equipped with 1/4" threaded connections. Wetted parts shall be constructed of 300 series stainless steel. Provide transducer with Viton and silicone O-rings for solutions containing water and/or glycol. Provide transducer with Buna-N O-rings for hydrocarbon solutions.
    - 4) Provide transducer with factory assembled 3-valve manifold assembly to allow for field calibration of transducer.
    - 5) Performance shall be as follows:
      - a) Accuracy:  $\pm\pm 0.25\%$  F.S.
      - b) Non-Linearity:  $\pm\pm 0.20\%$  F.S.
      - c) Hysteresis: 0.10%F.S.
      - d) Non-Repeatability: 0.05% F.S.
      - e) Compensated Temp Range: +30°F to +150°F
      - f) Long Term Stability: 0.5% F.S./year
- F. Current Measuring Devices:
- 1. Current Switches for Constant Speed Motors:
    - a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.
  - 2. Current Switches for Motors Controlled by VFD:
    - a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.
- G. Oxygen Deficiency Monitor:
- 1. Long-Life Zirconium Oxide Sensor: 10-year life expectancy.
  - 2. Measurement Range: 0-25%.
  - 3. Minimum Detection: 0.05% of oxygen.
  - 4. Accuracy/Repeatability:  $\pm\pm 0.1\%$  of range or  $\pm\pm 0.1\%$  of oxygen, whichever is greater.
  - 5. 90% full scale response times for specified range: 0-25% less than 12 seconds.
  - 6. Backlit Digital Display: High resolution 3/4" digit LCD. Reads full scale from 00.0% to 25.0%.
  - 7. Status LED: Indicates Power, Safe Operation, Alarm Conditions, and Loss of AC Power.
  - 8. Alarms: Two (2) fully adjustable oxygen concentration alarms. Preset for OSHA standards. 20.0% Caution and 19.5% Danger. Dry contacts 3A. @24VDC/115VAC.

9. Danger Alarm: 95dB danger alarm preset for 19.5%.
10. Data Logger: Logs data for 15 days at 1 minute intervals, 30 days at 2 minute intervals, etc.
11. Analog Output Signal: Isolated 4-20mA.
12. Battery Backup: One (1) hour.
13. Power Requirements: 115VAC, less than 10 watts.
14. Operating Temperature Range: 0°F to 130°F.
15. Polycarbonate enclosure suitable for use in an MRI room; mounting: wall mount.

## **2.8 CONDUIT AND BOXES**

- A. Conduit and Boxes: Refer to Electrical Section 26 05 33 for materials, sizing, and other requirements
  1. Refer to the Temperature Control Contractor notes located on the mechanical cover sheet for raceway and box color requirements.

## **2.9 WIRE AND CABLE**

- A. Wire and Cable: Refer to Electrical Section 26 05 13 for wire and cable materials.
  1. Wire and Cable Color: Refer to the Temperature Control Contractor notes located on the mechanical cover sheet for wire and cable color requirements.

## **PART 3 - EXECUTION**

### **3.1 GENERAL INSTALLATION**

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.
- D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed ADA mounting requirements.
- F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.
- G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.
- H. After completion of installation, test and adjust control equipment.
- I. Check calibration of instruments. Recalibrate or replace.
- J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.
- K. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.
- L. Remodeling:

1. All room devices as indicated on the drawings shall be removed by this Contractor. The Contractor shall also prepare the wall for finishes. Preparing the wall shall include patching old anchor holes (after the anchoring device has been removed) and sanding the wall to remove old paint outlines remaining from original devices. The wall shall be painted to match the existing wall prior to the installation of the new room device. If wall covering requires patching, the Contractor shall furnish new wall covering to match existing. If new wall covering is not available to match existing, the Contractor shall furnish a white acrylic or Plexiglas plate, 1/4" thick and sized to cover the void.
- M. Labels For Control Devices:
1. Provide labels indicating service of all control devices in panels and other locations.
  2. Labels may be made with permanent marking pen in the control panels if clearly legible.
  3. Use engraved labels for items outside panel such as outside air thermostats.
  4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

### **3.2 GRAPHIC DISPLAY**

- A. Create a customized graphic for each piece of equipment indicated on the itemized points list.
- B. Components shall be arranged on graphic as installed in the field.
- C. Include each graphic point listed in the itemized points list using real time data.
- D. Provide a graphic representation of the following:
  1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.
  2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.
  3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.
  4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
  5. Show the location of each thermostat on the floor plan.
  6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
  7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.

### **3.3 CONDUIT AND BOXES INSTALLATION**

- A. Conduit and Box Installation: Refer to Electrical Section 26 05 33 for execution and installation.
- B. Conduit and Box Identification (color and labeling) installation. Refer to Electrical Section 26 05 53 for raceway and box identification installation.
- C. Outlet Box Schedule: Thermostat/temperature sensor:
  1. Dry Interior Locations: Provide 4" square galvanized steel with raised cover to fit flush with finished wall line. When located in concrete block walls, provide square edge title cover of sufficient depth to extend out to face of block or masonry boxes.
  2. Other Conditions: Refer to Electrical Section 26 05 33 for requirements.

### **3.4 WIRE AND CABLE INSTALLATION**

- A. Wire and Cable Installation: Refer to Electrical Section 26 05 13 for execution and installation.
- B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.
2. Torque test conductor connections and terminations to manufacturer's recommended values.
3. Perform continuity test on all conductors.
4. Protection of cable from foreign materials:
  - a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
  - b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

### **3.5 PREPARATION FOR BALANCING**

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Check the calibration and setpoints of all controllers.
- C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
- D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.
- E. Verify the operation of all interlock systems.

### **3.6 TEST AND BALANCE COORDINATION**

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.
- C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.
- D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

### **3.7 DEMONSTRATION AND ACCEPTANCE**

- A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

### **3.8 INSTALLATION OF SENSORS**

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.
- F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.
- H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

**END OF SECTION**





**SECTION 23 09 13  
INSTRUMENTATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.

**1.2 REFERENCES**

- A. ANSI/AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.
- B. ANSI/AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.
- C. ANSI/AWWA C702 - Cold Water Meters - Compound Type.
- D. ANSI/AWWA C706 - Direct Reading, Remote Registration Systems for Cold Water Meters.
- E. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- F. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- G. ASTM E1 - Specification for ASTM Thermometers.

**PART 2 - PRODUCTS**

**2.1 PRESSURE GAUGES**

- A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for air, steam, water or oil application, 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze bushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.
- B. Manufacturers:
  - 1. Ashcroft
  - 2. Marsh
  - 3. Marshalltown
  - 4. Miljoco
  - 5. Trerice
  - 6. U.S. Gauge Figure 1901
  - 7. Weiss
  - 8. Weksler
  - 9. Wika.
- C. Select gauge range for normal reading near center of gauge.

**2.2 PRESSURE GAUGE ACCESSORIES**

- A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.
- B. Shutoff Valve: 1/2" ball valve as specified for each piping system.
- C. Pressure snubber, brass with 1/2" connections, porous metal type.
- D. All pressure gauge piping shall be minimum 1/2" 304 stainless steel pipe or copper tube.

**2.3 THERMOMETERS**

- A. Dial Type:
  - 1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.
  - 2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
  - 3. Stem lengths as required for application with minimum insertion of 2-1/2".
  - 4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.

5. Manufacturer:
  - a. Ashcroft
  - b. Marsh
  - c. Marshalltown
  - d. Miljoco
  - e. Tel-Tru
  - f. Trerice
  - g. U.S. Gauge
  - h. Weiss
  - i. Weksler, Wika.
- B. Alcohol/Spirit Filled Type:
  1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, and locking device to allow rotation of thermometer to any angle.
  2. Select thermometer for appropriate temperature range.
  3. Stem: Copper plated steel, aluminum, or brass for separable socket. Stem lengths as required for application with minimum insertion of 3".
  4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.
  5. Manufacturer:
    - a. Marsh
    - b. Miljoco
    - c. Trerice
    - d. Weiss
    - e. Weksler
    - f. Wika.
- C. Digital Type:
  1. 1/2" LCD digital display, solar powered, with high impact ABS case. Accuracy of 1% of reading or 1°F, whichever is greater. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
  2. Fahrenheit/Celsius switchable with -50/300°F range.
  3. Through-case potentiometer recalibration adjustment.
  4. Stem lengths as required for application, with minimum insertion of 2-1/2".
  5. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.. Thermometers for air shall have an aluminum or brass duct flange.
  6. Digital display shall operate at 10 Lux (one foot-candle) or more. Use this thermometer only where ambient temperatures are below 140°F and there is sufficient light under normal occupied space conditions for the digital display to function. Use a different type thermometer where there is inadequate light available (i.e., dark mechanical rooms, locations where the thermometer is shielded from light, etc.).
  7. Manufacturer:
    - a. Miljoco
    - b. Trerice
    - c. Weiss
    - d. Weksler
    - e. Wika.
- D. Dial Type with Remote Reading Dial:
  1. 4-1/2" diameter remote mounted, vapor actuated dial, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.

2. Select thermometers for appropriate temperature range.
  3. 0.13" diameter copper averaging bulb approximately 60" long. Install dial as shown on drawings and in location visible from floor. Insulate copper averaging bulb if required by manufacturer.
  4. Stem lengths as required for application with minimum insertion of 2-1/2".
  5. Thermometers for water, steam, or oil shall have brass or steel separable socket. Thermometer wells shall be stainless steel, pressure rated to match piping system design pressure; with 2 inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometers for air shall have an aluminum or brass duct flange.
  6. Manufacturer:
    - a. Ashcroft
    - b. Marsh
    - c. Marshalltown
    - d. Miljoco
    - e. Tel-Tru
    - f. Trerice
    - g. U.S. Gauge
    - h. Weiss
    - i. Weksler
    - j. Wika.
- E. Select scales to cover expected range of temperatures.

#### **2.4 TEST PLUGS**

- A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.
- B. Provide extended units for all plugs installed in insulated piping.
- C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.
  1. Manufacturers:
    - a. Sisco
    - b. Flow Design
    - c. Peterson Equipment
    - d. MG Piping Products Co.
    - e. Miljoco, Trerice
    - f. Watts Regulator.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General Installation Requirements:
  1. Install per manufacturer's instructions.
  2. Coil and conceal excess capillary on remote element instruments.
  3. Install gauges and thermometers in locations where they are easily read from normal operating level.
  4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.
- B. Pressure Gauges:
  1. Connect pressure gauges to suction and discharge side of all pumps.
  2. Provide 1/2" tubing for pressure gauge and gauge accessories.
  3. Provide snubber for each pressure gauge.
  4. Provide coil syphon for each pressure gauge connected to steam piping.
- C. Thermometers:
  1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
  2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

3. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

**END OF SECTION**

**SECTION 23 09 20**  
**VENTURI VALVE AIRFLOW CONTROL SYSTEM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Venturi Airflow Control Valve
- B. Controllers, Components
- C. Interface to FMCS

**1.2 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum five years' experience.
- B. The airflow system provider shall be an entity that designs, develops, manufactures, and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2008.
- C. Open loop venturi air valves that use damper position to represent flow must be calibrated on NVLAP accredited air stations.
- D. Closed loop venturi air valves that measure airflow and control to setpoint must be  $\pm\pm$  5% accurate over a 10:1 turndown. Third-party testing must be provided upon request.
- E. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under this section. Materials and installation to confirm to Class 1 or 2, California Administrative Code Title 24, Article E725, and as restricted under Division 26 of these specifications.

**1.3 REFERENCES**

- A. Air Conditioning and Refrigeration Institute
  - 1. ARI 880 - Performance Rating of Air Terminals
- B. American Society of Heating, Refrigeration, and Air Conditioning Engineers / American National Standards Institute
  - 1. ASHRAE/ANSI Standard 130, Methods for Testing Air Terminal Units
- C. American National Standards Institute / American Society of Heating, Refrigeration, and Air Conditioning Engineers
  - 1. ANSI/ASHRAE 135-2012: BACnet® - A Data Communication Protocol for Building Automation Systems (including Standard and all published Addenda)

**1.4 SUBMITTALS**

- A. Submit shop drawings per Sections 23 05 00 and 23 09 00. In addition, submit an electronic copy of the shop drawings in .pdf format to the Owner for review.
- B. Refer to Section 23 09 00 for additional information.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Storage and Handling Requirements:
  - 1. Prior to installation, the control system components shall be stored in dry conditions within an environment complying with the product specifications as shown on product data sheets within the submittals.
  - 2. The system products shall be handled and transported in a manner consistent with trade practices for control systems and instruments.

**1.6 JOB CONDITIONS**

- A. Cooperation with Other Trades: Coordinate the work of this section with that of other sections to ensure that the work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the contract documents for possible conflicts between the work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

**1.7 WARRANTY**

- A. Warranty shall commence upon the date of shipment and extend for a period of 60 months for all airflow control devices and 36 months for all other control system components.
- B. Refer to Section 23 05 00 for warranty requirements.

- C. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation, or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.
- D. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.
- E. Update all software and backups during the warranty period and all user documentation on the Owner's archived software disks.

#### **1.8 Pre-Installation Meetings**

- A. The critical environment control system representative shall review the proper installation of the system with the Sheet Metal Contractor and the BAS Contractor.
- B. Project Installation Phase: The representative shall make periodic visits to the project job site to ensure that the system is being installed properly to assure optimal performance and that the location and orientation of the control valves is consistent for proper operation and future Owner maintenance. Any discrepancies shall first be brought to the attention of the appropriate subcontractor. If no action is taken by said subcontractor, the representative shall bring these issues to the Project Manager, Architect/Engineer, or Owner's Representative for resolution.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Phoenix Controls
- B. Critical Room Control (CRC)
- C. Price Industries, Inc.
- D. Johnson Controls Critical Environments

#### **2.2 AIRFLOW CONTROL SYSTEMS**

- A. A critical environment control system shall be furnished and installed to control the airflow into and out of laboratories and/or other areas as noted on the plans. The exhaust flow rate of a fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator's presence in front of the fume hood. The control system shall vary the amount of makeup/supply air into the room to operate the room at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum ventilation rates, and maintain pressurization in relation to adjacent spaces (positive or negative). The critical environment control system shall be capable of operating as a standalone system or as a system integrated with the Facility Management and Control System (FMCS). An optional locally mounted user interface terminal shall be available to allow room-level control variables to be displayed, and where appropriate, edited to adjust control operation.

#### **2.3 COMPONENTS**

- A. Usage Based Control Equipment:
  - 1. For variable air volume (VAV) systems, a sash sensor shall be provided to measure the height of each vertically moving fume hood sash. A sash sensor shall also be provided to measure the opening of horizontal overlapping sashes. Control systems employing sidewall-mounted or through-the-wall (TTW) velocity sensors to control the fume hood exhaust airflow shall utilize dual air path with chip thermistor technology that can be demonstrated to meet sash response that meets ANSI Z95 performance guidelines. Hot wire anemometer sidewall sensors, or sensors that do not meet speed of response, are not acceptable.
  - 2. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow setpoints to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to ensure flow through the fume hood even with the sash fully closed.
- B. Airflow Control Device/ Venturi Valve - General:
  - 1. The valve assembly manufacturer's airflow control device shall be registered to ISO 9001.

2. Airflow control device shall be HCAI tested and certified per 2013 CBC, 2012 IBC, ASCE 7-10, and ICC-ES-AC-156.
3. An open loop airflow control device shall be mechanically 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 (within product specifications) or quantity of airflow controllers on a manifolded system.
4. A closed loop airflow control device shall measure airflow and control to a setpoint. Closed loop air valve shall be  $\pm 5\%$  accurate over a 10:1 turndown.
5. The airflow control device shall maintain accuracy within  $\pm 5\%$  of signal to setpoint.
6. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
7. No rotational/axial orientation requirements shall be required to ensure accuracy and/or pressure independence.
8. The airflow control device shall maintain pressure independence regardless of loss of power. "Electronically pressure independent" devices are not acceptable.
9. Valve manufacturer will provide minimum required differential pressure in writing for each size valve they offer.
10. Devices that require duct static pressure to be increased to achieve maximum flow shall not be acceptable.
11. The airflow control device shall be constructed of:
  - a. The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of minimum 16 gauge aluminum. The device's shaft and internal "S" link shall be made of 316 stainless steel. The shaft support brackets shall be made of galvanized (non-shutoff valves) or 316 stainless steel (shutoff valves). The pivot arm shall be made of aluminum (for non-shutoff valves) and 303/304 stainless (for shutoff valves). The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a PP (polypropylene), PPS (polyphenylene sulfide) composite, or Teflon. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used. Silencers shall be absorptive type with polymer-lined acoustic media.
  - b. The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, 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 "S" 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 PP (polypropylene), PPS (polyphenylene sulfide) composite, or Teflon.
  - c. The airflow control device for highly corrosive airstreams shall be as described directly above. In addition, they shall have no exposed aluminum or stainless steel components. Shaft support brackets, pivot arm, and pressure independent springs shall have a baked-on, corrosion-resistant phenolic coating in addition to the materials defined directly above. The internal "S" link, nuts, bolts, and rivets shall be epoxy phenolic coated stainless steel. Only devices clearly defined as "high corrosion resistant" on project drawings will require this construction.

- d. The airflow control device for extremely corrosive airstreams, such as acid digestion fume hoods, shall have a PVDF (polyvinylidene fluoride fluoropolymer) 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 with PVDF coating. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel with PVDF coating. The pressure independent springs shall be a spring-grade stainless steel with Teflon (PTFE) coating. The internal nuts, bolts, and rivets shall be stainless steel with PVDF coating. All shaft bearing surfaces shall be made of Teflon or PPS (polyphenylene sulfide) composite. Only devices clearly defined as "extremely corrosion resistant" on project drawings will require this construction.
    - 1) Note: Airflow control devices utilizing vortex shedding sensors and installed in fume hoods or corrosive environments MUST be constructed with stainless steel bodies and MUST have stainless steel vortex shedding sensors. Polycarbonate vortex shedding sensors are NOT acceptable in corrosive environments.
12. Actuation:
    - a. For high speed electrically actuated VAV operation, a CE certified, UL listed, IP56 rated for dust and water, 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 fail-to-last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications). During normal operation, the high speed actuated airflow control device shall initiate valve movement and achieve the commanded airflow value with no more than 5% overshoot or undershoot within 1 second or less.
    - b. For standard speed electrically actuated VAV operation, a CSA certified, UL recognized (IP54 rating and CE certification optional on single valves, standard on dual valves) electronic actuator shall be factory mounted to the valve. The failsafe state for standard speed operation valves shall be fail to last position unless otherwise noted.
    - c. During normal operation, the standard speed actuated airflow control device shall initiate valve movement and achieve the commanded airflow value with no more than 5% overshoot or undershoot within 60 seconds (90 seconds for a shutoff valve from shutoff to maximum flow or vice versa).
      - 1) Standard speed actuation should not be used for valves that are connected to VAV fume hoods.
      - 2) Standard speed actuation can be used on 2-state fume hoods or vented cabinets or snorkels with on/off conditions.
  13. The room-level airflow control devices shall function as a standalone network.
  14. There shall be no reliance on external or building-level control devices to perform room-level control functions. Each control system shall have the capability of performing fume hood control, pressurization control, standard and advanced temperature control, humidity control, and implement occupancy and emergency mode control schemes.
  15. The critical environment control system shall have the option of digital integration with the FMCS.
  16. NVLAP Accreditation (Lab Code 200992-0) (if applicable):
    - a. Each airflow control device shall be factory characterized on air stations NVLAP Accredited (a program administered by NIST) to ISO/IEC 17025:2005 standards.



- b. Each airflow control device shall be factory characterized to the job specific airflows as detailed on the plans and specifications using NVLAP Accredited air stations and instrumentation having a combined accuracy of no more than  $\pm\pm 1\%$  of signal (5,000 to 250cfm),  $\pm\pm 2\%$  of signal (249 to 100cfm) and  $\pm\pm 3\%$  of signal (199 to 35cfm). Electronic airflow control devices shall be further characterized and their accuracy verified to  $\pm\pm 5\%$  of signal at a minimum of 48 different airflows across the full operating range of the device.
  - c. Each airflow control device shall be marked with device-specific factory characterization data. At a minimum, it should include the room number, tag number, serial number, model number, eight-point characterization information (for electronic devices), date of manufacture, and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation. Characterization data shall be stored indefinitely by the manufacturer and backed up off site for catastrophic event recovery.
- C. Exhaust and Supply Airflow Device Controller:
1. 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.
  2. During normal operation, the airflow control device shall initiate valve movement and achieve the commanded airflow value with no more than 5% overshoot or undershoot within:
    - a. 1 second or less with high speed actuation.
    - b. 60 seconds for standard speed actuation (90 seconds from shutoff to max flow and vice versa).
  3. The airflow control device shall store its control algorithms in non-volatile, rewriteable memory. The device shall be able to be standalone or to be networked with other room-level digital airflow control devices using an industry standard protocol.
  4. 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 separate room-level controller shall be required.
  5. The airflow control device shall use industry standard 24 VAC power.
  6. The airflow control device shall have provisions to connect a commissioning tool, and every node on the network shall be accessible from any point in the system.
  7. The airflow control device shall have built-in integral input/output connections that address fume hood 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:
    - a. Three universal inputs capable of accepting 0 to 10 VAC, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25°C thermistor temperature sensors.
    - b. One digital input capable of accepting a dry contact or logic level signal input.
    - c. Two analog outputs capable of developing either a 0 to 10 VAC @ 1 mA (10Kohm min) or 4 to 20 mA (500 ohm max) linear control signal.
    - d. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 VAC/VAC.
  8. The airflow control device shall meet FCC Part 15 Subpart J Class A, CE, and CSA Listed per file #228219.
  9. The airflow control device shall be ROHS compliant.
- D. Airflow Control Device/Venturi Valve - Leakage:
1. Two types of shutoff airflow devices shall be available: standard shutoff (no gasket) and low leakage shutoff (with gasket).

2. The shutoff airflow control device shall have shutoff leakage and casing leakage of no greater than the following (with 5.0" wc static pressure):

Shut-off Valve Type and Airflow Range	Shut-off Leakage	Casing Leakage
Standard shutoff devices up to 1600 CFM/472 L/s	6 CFM	0.060 CFM

3. Manufacturer shall provide comprehensive leakage charts generated from ASME N510 pressure decay testing. Standard shutoff devices shall be tested up to and including 5" wc static pressure. Low-leakage shutoff devices shall be tested up to and including 30" wc static pressure.

E. Two-Position Exhaust Airflow Control Device/Venturi Valve:

1. The airflow control device shall provide functionality for constant volume, two position, or fully modulating. Two-position devices requiring feedback shall generate a 0 to 10 volt feedback signal that is linearly proportional to its airflow. All two-position devices shall be either networked or hard-wired into the room-level network to be considered under pressurization control.

**2.4 PERFORMANCE/DESIGN CRITERIA**

- A. Each dedicated critical environment control system shall support a minimum of 20 network controlled airflow devices.
- B. The system shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood's exhaust airflow to maintain a constant face velocity over a minimum range of 20% to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio shall be 5 to 1.
- C. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be from 1 to 1-1/2 feet per second.
- D. 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.
- E. The 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).
- F. The system shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement, vortex shedding measurement, or velocity measurement to control room pressurization are unacceptable.
- G. The system shall maintain specific airflow ( $\pm 5\%$  of signal) with a minimum turndown as specified in Components, Airflow Control Device/ Venturi Valve - General above to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.
- H. Airflow Control Sound Specification:
  1. The critical environment control system manufacturer shall provide comprehensive sound power level data for each size airflow control device. All data shall be obtained from testing in accordance with ASHRAE/ANSI Standard 130, Methods of Testing Air Terminal Units.
  2. All proposed airflow control devices shall include discharge, exhaust, and radiated sound power level performance.

3. If the airflow control device cannot meet the sound power levels required to achieve the sound criteria appropriate for the space, as determined by the Architect/Engineer, a properly sized sound attenuator must be used. All sound attenuators must be of a packless design (constructed of at least 18 gauge 316L stainless steel when used with fume hood exhaust) with a maximum pressure drop at the device's maximum rated flow rate not to exceed 0.20"wc.

## **2.5 INTERFACE TO FACILITY MANAGEMENT AND CONTROL SYSTEMS**

- A. The critical environment control system network shall have the capability of digitally interfacing with the FMCS. The required software interface drivers shall be developed and housed in one or more dedicated interface devices furnished by the supplier. Open protocol native BACnet is preferred. For providers who cannot offer native BACnet, a detailed submittal or BACnet integration requirements shall be provided with submittal data.
- B. All room-level points shall be available to the FMCS for monitoring or trending. The critical environment control system integrator and/or room manager shall maintain a cache of all points to be monitored by the FMCS. The room-level airflow control devices shall continually update this cache.
- C. Room Level Integration:
  1. Device shall be non-proprietary. No special tools shall be required to make the system available.
  2. If the room level integration device drops off the network or loses power, it shall not cause the zone balance, temperature control, or fume hood devices to lose control. The room level valve devices should operate independently of the room level integration device. Space controller, room controller with hardwired control of hood, general exhaust and supply valves, or PLC with hardwired control of fume hood, general exhaust or supply valves for zone balance, temperature control, room offset, etc. are not acceptable.
  3. Room level controller shall be able to integrate to FMCS through BACnet/IP, BACnet/Ethernet, BACnet MS/TP through onboard communication adapters and shall be field configurable/upgradable.
- D. Room Manager:
  1. Critical environment integration shall support distributed network architecture from room level BACnet MS/TP segment FTT-10 bus to a dedicated BACnet MS/TP segment, building BACnet/Ethernet, or BACnet/IP building backbone using single or multiple IP addresses. Backbone communication protocol must be field selectable/upgradable.
  2. Devices in a room or zone will operate independent of building level communications, maintaining integrity of the airflow. Critical environment control system building level communication, or loss of, will not disrupt the communication between devices in a room or zone.
  3. Critical environment control system integration shall provide an easy means to access room level device health status at a room-by-room or building-wide level.
  4. Critical environment control system integration shall provide an easy means to access test and balance functions at a room-by-room basis. Test and balance functions should include:
    - a. Setting the devices in the room to various conditions in order to read airflow.
    - b. Manually override the outputs for testing purposes.
    - c. Adjust airflow to meet field acceptance tests.
  5. Critical environment control system integration must work with the FMCS for long-term trending.
  6. Critical environment control system integration shall provide optional software to manage local backup and restore, entire site device management, building-wide test and balance functions, building-wide diagnostic tools, and building-wide configuration tools. Software shall be field upgradable to support graphical dashboard displays.

## 2.6 ACTIVE PRESSURE CONTROL SYSTEMS

- A. Each pressurized space that requires active pressure control shall have a dedicated airflow space pressurization control system to control the airflow in and out of the space to maintain the desired pressurization level, either positive or negative. The space pressure control system shall function as an interactive control system consisting of variable volume flow control devices, all of which shall be under control with flow feedback into the zone pressure control function. The space pressure control system shall vary the amount of makeup/supply or exhaust/return air into or out of the room to operate the space at the lowest possible airflow rates necessary, to maintain temperature control, achieve minimum ventilation rates, and maintain space pressurization in relation to adjacent spaces (positive or negative). The space pressurization airflow control system shall operate as a standalone system with the ability to operate with the building management system (FMCS). An optional locally mounted user interface terminal shall be available to allow room-level control variables to be displayed, and, where appropriate, edited to adjust control operation.
- B. Pressure Control:
  - 1. The space pressure control shall maintain a minimum ventilation flow rate to obtain the desired air changes per hour. Two minimum ventilation flow setpoints shall be provided: one for occupied periods and one for unoccupied periods; which setpoint is used shall be a function of the occupancy control state. The minimum ventilation setpoints shall be configurable as either fixed values or writable from the FMCS.
  - 2. The pressure control function shall maintain a fixed flow for either the supply or exhaust side devices under control and modulate the controlled exhaust or supply side devices in order to maintain space pressurization. The space pressure control system shall provide for a base fixed volumetric offset setpoint to ensure directional airflow, even if the pressure control function is not running. The pressure control variable shall be configurable to have either or both a filtered control signal and/or a controlled ramp time to dampen the control signal, if required.
- C. Performance:
  - 1. Each airflow control device 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).
  - 2. After proper commissioning, the space pressurization control system shall maintain space pressurization capable of controlling to  $\pm 0.01$ "wc of the desired setpoint.
  - 3. The airflow control system shall maintain specific airflow ( $\pm 5\%$  of signal) with a minimum 8 to 1 turndown to ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.
  - 4. Provide all controller electronics within finished steel enclosures mounted on the air valves or wall-mounted enclosures if shown on plans.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. The Facility Management and Control System (FMCS) or Building Automation System (BAS) Contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels, or use of fixed sash sensors with take-up reels is also permitted. Sash interface boxes with interface cards shall be mounted in an accessible location. Sidewall sensors are acceptable for use to control the fume hood valves. Hot wire thermal anemometer type side wall sensors are not acceptable. The sidewall sensor must maintain a speed of response per ANSI-Z95.

- B. The FMCS Contractor shall install all critical environment control system devices in an accessible location.
- C. The FMCS Contractor shall install an appropriately sized and fused 24 VAC transformer suitable for NEC Class II wiring.
- D. All cable shall be furnished and installed by the FMCS Contractor. The FMCS Contractor shall terminate and connect all cables as required. The FMCS Contractor shall utilize cables specifically recommended by the airflow controls supplier.
- E. The Mechanical Contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
- F. The Mechanical Contractor shall provide and install all reheat coils, neutralizers, silencers, and transitions.
- G. The Mechanical Contractor shall provide and install insulation as required.
- H. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

### **3.2 SYSTEM STARTUP**

- A. System startup shall be provided by a factory trained and authorized representative of the critical environment control system manufacturer. Startup shall include calibrating the fume hood monitor and any combination sash sensing equipment, as required. Startup shall also provide electronic verification of airflow (fume hood exhaust, supply, makeup, general exhaust, or return), system programming and integration to FMCS (when applicable).
- B. The Balancing Contractor shall be responsible for final verification and reporting of all airflows. For all field flow measurement devices, the balancer shall produce a flow report that documents field flows vs. device flow and associated error. This shall be tabulated for each device location at several flows including min and max. Cost and responsibility to meet the specified performance shall be carried by the ACS.

### **3.3 CLOSEOUT ACTIVITIES**

- A. Training
  - 1. The critical environment control system supplier shall furnish a minimum of eight (8) 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 fume hood monitor calibration, general procedures for verifying airflows of air valves, and general troubleshooting procedures.
  - 2. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

**END OF SECTION**



**SECTION 23 21 00  
HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pipe and Pipe Fittings
- B. Valves
- C. Strainers
- D. System Piping Schedule

**1.2 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.
- C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
  - 1. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

**1.3 REFERENCES**

- A. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- B. ANSI/AWS D1.1 - Structural Welding Code.
- C. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- D. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- E. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- F. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.
- G. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- H. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.
- I. ASME - Boiler and Pressure Vessel Code.
- J. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
- K. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
- L. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
- M. ASME B16.5 - Pipe Flanges and Flanged Fittings.
- N. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- O. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
- P. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
- Q. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
- R. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- S. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
- T. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- U. ASME B16.51 - Copper And Copper Alloy Press-Connect Pressure Fittings.
- V. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
- W. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
- X. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- Y. ASME B31.9 - Building Services Piping.
- Z. ASME Section 9 - Welding and Brazing Qualifications.
- AA. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
- BB. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- CC. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

- DD. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- EE. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- FF. ASTM A536 - Standard Specification for Ductile Iron Castings
- GG. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
- HH. ASTM B32 - Standard Specification for Solder Metal.
- II. ASTM B88 - Seamless Copper Water Tube.
- JJ. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
- KK. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.
- LL. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- MM. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.
- NN. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.
- OO. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
- PP. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
- QQ. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- RR. ASTM D2992 - Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.
- SS. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.
- TT. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- UU. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- VV. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.
- WW. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.
- XX. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
- YY. ASTM E413-87 - Classification for Rating Sound Insulation
- ZZ. ASTM F2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
- AAA. ASTM F3226 - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems.
- BBB. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

#### **1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.
- B. Grooved joint couplings and fittings shall be referred to on drawings and product submittals, and be identified by the manufacturer<sup>TM</sup>'s listed model or series designation.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

#### **1.6 COORDINATION DRAWINGS**

- A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.



## **PART 2 - PRODUCTS**

### **2.1 STEEL PIPE (ABOVE GRADE)**

- A. Design Pressure 125 psig, Maximum Design Temperature 225°F (230°F for grooved couplings).
- B. Black Steel; Standard Weight; Threaded Joints:
  - 1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.
  - 2. Joints: Screwed.
  - 3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.
  - 4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.
- C. Black Steel; Standard Weight; Welded or Flanged Joints:
  - 1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
  - 2. Joints: Butt-welded or flanged.
  - 3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
  - 4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.
- D. Black Steel; Standard Weight; Mechanically Coupled Grooved Joints:
  - 1. Pipe: Standard weight black steel, grooved ends, ASTM A53, Type E or S, Grade B.
  - 2. Joints: Grooved type, with Grade E EPDM molded pressure-responsive gaskets suited for 32°F to 230°F per ASTM D2000.
    - a. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9, and to prevent mis-assembly due to overshift. Housings cast with alignment indicator notch for visual proper alignment to adjoining fitting. Center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth. Installation ready for direct stab installation without field disassembly. Design Basis: Victaulic 107V.
      - 1) Usage: All locations unless noted elsewhere.
    - b. Flexible Type: Housing cast with horizontal bolt pads to provide vibration attenuation and stress relief. Design Basis: Victaulic 177N or 77.
      - 1) Usage: As shown on drawings and or first three joints adjacent to vibrating equipment (e.g., chillers, boilers, pumps, air handling equipment, etc.).
    - c. Provide AGS two-segment couplings for pipe sizes 14" and larger, with wide-width FlushSeal gasket and lead-in chamfer on housing key. Design Basis: Victaulic Style W07 (rigid) and Style W77 (flexible).
  - 3. Fittings: ASTM A536 Grade 65-45-12 ductile, ASTM A234 Grade WPB wrought steel, or factory manufactured from ASTM A53 steel pipe, grooved type.
  - 4. Flanges: Grooved end, flanged adapter for direct connection to ANSI Class 150 flanged components.
    - a. Flange adapters to be used for connecting grooved piping to equipment flanges only. Grooved flange adapters shall not be used to connect lug style valves to grooved piping. Design Basis: Victaulic Style 741 and W741.
  - 5. Optional Packaged Coupling/Fittings:

- a. At the Contractor™™s option, couplings/fittings for plain-end carbon steel piping may be used on applicable piping systems in sizes NPS 1/2" thru 2" (DN15 through DN50) and working pressure to 300 psi. Fittings shall consist of a ductile iron housing conforming to ASTM A536, Grade 65-45-12, with installation-ready ends, full body gasket liner, zinc-electroplated steel bolts and nuts, and 300 Series stainless steel retainer. Design Basis: Victaulic QVSD System.

## 2.2 COPPER PIPE (ABOVE GRADE)

- A. Design Pressure 125 psig. Maximum Design Temperature 225°F.
- B. Copper Pipe; Type L; Soldered Joints:
  1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
  2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
  3. Fittings: Wrought copper solder joint, ASME B16.22.
- C. Copper Pipe; Type L; Mechanical Press Connection:
  1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
  2. Joints: Mechanical press connection.
  3. Fittings: Copper, ASME B-16.51, with embedded EPDM O-ring, NSF-61.
  4. Fitting Identification: Press ends shall provide the ability to identify an unpressed fitting from the floor prior to testing. The function of this feature is to provide the installer quick and easy identification of connections that have not been pressed prior to putting the system into operation.
  5. Special Requirements: Mechanical press fitting manufacturer shall provide contractor training prior to installation.
  6. Manufacturers:
    - a. Viega ProPress.
    - b. Elkhart Xpress.
    - c. NIBCO Press System Fittings and Valves.
    - d. Merit Brass
    - e. Mueller Streamline PRS.
- D. Copper Pipe; Type L; Mechanically Coupled Grooved Joints:
  1. Pipe: Type L hard drawn seamless copper tube, ASTM B88, roll grooved per mechanical coupling manufacturers specifications.
  2. Design Pressure: 300 psi; Maximum Design Temperature: 200°F.
  3. Joints: Mechanically coupled grooved type.
  4. Mechanical Couplings: Ductile iron, ASTM A-536, (Grade 65-45-12), rigid grooved type with offsetting angle-pattern bolt pads, coated with non-toxic, no-lead, copper-colored enamel paint, ASTM A449 compliant bolts and hex nuts zinc electroplated plated, ASTM B-633. Installation ready for direct stab installation without field disassembly. Design Basis: Victaulic Style 607.
  5. Gaskets: Molded pressure responsive design, EPDM Grade E, ASTM D-2000, suitable for hydronic water with temperatures ranging from 32°F to 230°F (.
  6. Fittings: Copper, ASTM B-75 and ANSI B-16.22, full flow wrought copper or ANSI-B16.18 cast bronze, manufactured by mechanical coupling manufacturer. Manufactured to copper tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
  7. Flanges: Grooved end type, Ductile iron, ASTM A-536, (Grade 65-45-12), Flange shall conform to ANSI Class 125 cast iron and Class 150 steel flange bolt hole pattern, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633.
    - a. Flange adapters to be used for connecting grooved piping to equipment flanges only. Grooved flange adapters shall not be used to connect lug style valves to grooved piping Design Basis: Victaulic Style 641.
  8. Transition Couplings: Grooved mechanical coupling rated for 300 psi CWP and 250°F. Consisting of two ductile iron housings, Grade "EHP" EPDM gasket and bolts and hex nuts zinc electroplated plated, ASTM B-633.

- a. Provides a single coupling connection for grooved end stainless steel pipe to grooved end copper tubing of the same nominal size. For use only on Types 304 or 316 Schedules 10S and 40S stainless steel pipe, and ASTM B88 Types K, L and M and ASTM B306 Type DWV copper tubing. Design Basis: Victaulic Style 644.
9. Manufacturers:
  - a. Gruvlok
  - b. Victaulic
  - c. Grinnell
10. Copper; Type M; Mechanical Press Connection: Tubing: Type M (or thicker) drawn temper seamless copper tube, ASTM B88.
11. Joints: Mechanical press connection.
12. Fittings: Copper, ASME B-16.51, with embedded EPDM O-ring, NSF-61.
  - a. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding are acceptable.
13. Limitations: Equipment drains and overflows only. No pressure pipes.
14. Fitting Identification: Press ends shall provide the ability to identify an unpressed fitting from the floor prior to testing. The function of this feature is to provide the installer quick and easy identification of connections that have not been pressed prior to putting the system into operation.
15. Special Requirements: Mechanical press fitting manufacturer shall provide contractor training prior to installation.
16. Manufacturers:
  - a. Viega ProPress
  - b. Elkhart Xpress
  - c. NIBCO Press System Fittings and Valves
  - d. Merit Brass
  - e. Mueller Streamline PRS
- E. Copper; DWV; Soldered:
  1. Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.
  2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
  3. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

### 2.3 VALVES

- A. Shutoff Valves:
  1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
  2. Gate Valves(Steel Pipe):
    - a. GA-1: 2" and under, 125 psi S @ 353°F, 300 psi WOG @ 150°F, screwed, bronze, rising stem, screwed bonnet.
      - 1) Manufacturers:
        - a) Crane #431
        - b) Hammond #IB641
        - c) Stockham #B122
        - d) Walworth #56
        - e) Milwaukee #1150
        - f) Watts #B-3210
        - g) NIBCO #T-131.
      - b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, iron body, bronze mounted, OS&Y.
        - 1) Manufacturers:
          - a) Crane #465-1/2
          - b) Hammond
          - c) Stockham #G623

- d) Walworth
  - e) Milwaukee #F2885
  - f) Watts #F-503
  - g) NIBCO F-617-O.
3. Gate Valves (Copper Pipe):
- a. GA-5: 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, solder bronze.
    - 1) Manufacturers:
      - a) Crane #1334
      - b) Stockham #B108
      - c) Walworth #4SJ
      - d) Watts #B-3101
      - e) NIBCO #S-111.
4. Ball Valves:
- a. BA-1 (Steel and Copper): 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals.
    - 1) Manufacturers:
      - a) Apollo #77C-140
      - b) Stockham #S-206 BR1-R
      - c) Milwaukee #BA-400
      - d) Watts
      - e) Nibco #585-70-66
      - f) National Utilities Co.
      - g) RUB.
    - 2) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.
    - 3) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
  - b. BA-1A (Steel): 2-1/2" and 3", 125 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals.
    - 1) Manufacturers:
      - a) Apollo #88A-100
      - b) Nibco #F510-CS/66
      - c) Milwaukee #F90.
    - 2) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

- 3) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

## 2.4 THROTTLING VALVES

### A. Throttling Valves (Steel):

1. For pipe systems where mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
2. Globe Valves (Steel Pipe):
  - a. GL-1: 3" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze.
    - 1) Manufacturers:
      - a) Crane #7TF
      - b) Stockham #B22T
      - c) Walworth #95
      - d) Milwaukee #590
      - e) Hammond #IB413T
      - f) Watts #B-4010-T
      - g) or NIBCO #T-235.
3. Globe Valves (Copper Pipe):
  - a. GL-5: 2" and under, 125 psi saturated steam, 300 psi WOG, solder, bronze.
    - 1) Manufacturers:
      - a) Hammond #IB423
      - b) Stockham #B24T
      - c) Milwaukee #1590
      - d) Watts #B-4011-T
      - e) NIBCO #S-235.
4. Ball Valves (Steel and/or Copper):
  - a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop.
    - 1) Manufacturers:
      - a) Apollo #70-120
      - b) Stockham #S-216BR-R
      - c) Milwaukee #BA-100
      - d) Watts #B-6000
      - e) Hammond #8501
      - f) Nibco #580-70.

## 2.5 STRAINERS

- A. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
- B. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F
  1. Manufacturers:
    - a. Armstrong #F4SC
    - b. Metraflex #TS

- c. Mueller Steam Specialty Co. #351
  - d. Sarco #BT
  - e. Watts #777
  - f. NIBCO T-122-A.
- C. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 353°F, 175 psi WOG @ 150°F.
- 1. Manufacturers:
    - a. Armstrong #A1FL
    - b. Metraflex #TF
    - c. Mueller Steam Specialty Co.#758
    - d. Sarco #CI-125
    - e. Watts #77F-D
    - f. Victaulic #732 or #W732
    - g. NIBCO F-721-A.
- D. ST-3: Grooved End Strainers: Ductile iron body, 300 psi CWP, grooved ends with coupled cover for strainer maintenance, with stainless steel basket. Design Basis: Victaulic Style 732 and AGS W732.
- E. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:
- 1. Pipe Size:
    - a. 1/4" - 2": 1/32" screen
    - b. 2-1/2" - 8": 1/16" screen
    - c. 10" and Up: 1/8" screen
- F. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- G. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Ream pipe and tube ends, remove burrs, bevel plain-end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- D. Connect to all equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

#### **3.2 SYSTEMS, PIPING, AND VALVE SCHEDULE**

- A. High Temperature Heating Water (Above Grade - maximum 400°F):
  - 1. Black Steel; Schedule 80; Welded Joints: All Sizes
- B. Heating Water (Above Grade - maximum 200°F unless noted otherwise below):
  - 1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
  - 2. Black Steel; Standard Weight; Plain End Mechanical Coupled: 2" and Under
  - 3. Copper Pipe; Type L; Soldered Joints: 2" and Under
  - 4. Copper Pipe; Type L; Mechanical Press Connection: 4" and Under
  - 5. Black Steel; Standard Weight; Grooved Joints: 2-1/2" and Over
  - 6. Copper Pipe; Type L; Grooved Joints: 2-1/2" and Over
  - 7. Polypropylene; Maximum SDR 7.3; Socket or Electrofusion: All Sizes maximum of 185°F.
  - 8. Shutoff Valves: GA-1, GA-5, BA-1
  - 9. Throttling Valves: GL-1, GL-5, BA-9
  - 10. Strainers: ST-1, ST-2, ST-3
- C. Condenser Water (Above Grade):
  - 1. Black Steel; Standard Weight; Threaded Joints: 2" and Under
  - 2. Black Steel; Standard Weight; Mechanical Coupled: 2" and Under
  - 3. Copper Pipe; Type L; Soldered Joints: 2" and Under
  - 4. Copper Pipe; Type L; Mechanical Press Connection: 4" and Under
  - 5. Black Steel; Standard Weight; Welded or Flanged Joints: 2-1/2" and Over

6. Shutoff Valves: GA-1 GA-2 GA-5), BA-1
7. Throttling Valves: GL-1, GL-5, BA-9
8. Strainers: ST-1, ST-2, ST-3

### 3.3 TESTING PIPING

- A. Test pipes underground or in chases and walls before piping is concealed.
- B. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
- C. Test the pipe with water at 1.5 times the design pressure but not less than 125 psig pressure. Hold pressure for at least two hours.
- D. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

### 3.4 CLEANING PIPING

- A. Assembly:
  1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
  2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
  3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
  4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.
- B. Chemical Cleaning:
  1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
  2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
  3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.
  4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 23 25 00. The system shall not be allowed to sit empty for any length of time.
  5. When system water is clear, remove, clean and replace all strainers.
  6. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.
  7. Chemical cleaning applies to the following systems:
    - a. Heating Water
    - b. Chilled Water
    - c. Glycol Water
    - d. Heating/Cooling Water
    - e. Condenser Water

### 3.5 INSTALLATION

- A. General Installation Requirements:
  - 1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
  - 2. Install piping to conserve building space, and not interfere with other work.
  - 3. Group piping whenever practical at common elevations.
  - 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
  - 6. Install bell and spigot pipe with bells upstream.
  - 7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
  - 8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.
- B. Installation Requirements in Electrical Rooms:
  - 1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.
- C. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):
  - 1. All piping in MRI rooms shall be non-ferrous regardless of materials described on Part 2.
- D. Valves/Fittings and Accessories:
  - 1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
  - 2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
  - 3. Provide clearance for installation of insulation, and access to valves and fittings.
  - 4. Prepare pipe, fittings, supports, and accessories for finish painting.
  - 5. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
  - 6. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
  - 7. Provide flanges or unions at all final connections to equipment, traps and valves.
  - 8. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
  - 9. Horizontal swing check valves may only be installed in horizontal position. Do not install horizontal swing check valves in upward or downward flow direction. Where upward or downward flow installation is required, use spring-assisted, non-slam check valve.

### 3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.



- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. 2-1/2" and larger fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

### 3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

### 3.8 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
  - 1. Must have at least same pressure rating as the main.
  - 2. Header or main must be 2-1/2" or over.
  - 3. Branch line is at least two pipe sizes under header or main size.

### 3.9 JOINING OF PIPE

- A. Threaded Joints (Steel Pipe):
  - 1. Ream pipe ends and remove all burrs and chips.
  - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
  - 3. Apply Teflon tape to male threads.
- B. Flanged Joints (Steel Pipe):
  - 1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
  - 2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
  - 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
  - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
  - b. Maximum pressure rating of at least 250 psig.
  - c. Minimum temperature rating: -10°F.
  - d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.
  - e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.
- C. Solder Joints (Copper Pipe):
  1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
  2. Flux shall be non-acid type conforming to ASTM B813.
  3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470°F.
- D. Welded Joints (Steel Pipe):
  1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
  2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
  3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
  4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
  5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.
- E. Mechanically Coupled Grooved Joints (Steel and Copper and HDPE):
  1. Grooved connections shall mechanically engage, lock and seal the grooved pipe ends in a positive couple. Each coupling shall have ductile iron housing clamps, steel bolts and nuts, and sealing gasket designed so internal pressure increases the tightness of the seal. Couplings must be installation-ready style for quick installation in sizes through 12" and AGS type for 14" and larger, and no more than two-piece housings.
  2. All work, including pipe grooving, shall be accomplished in accordance with manufacturer's published instructions.
  3. Final tightening of bolts shall be with a torque wrench to ensure equal tension in all bolts.
  4. All fittings shall be provided by one manufacturer. Mixing grooved components is not acceptable.
  5. Product Warranty:

- a. Standard: One-year product warranty. A factory-trained manufacturer's representative shall visit the site for contractor training and installation observation.
    - 1) On-site Training: Manufacturer's factory trained representative shall provide training of contractor's field personnel in use of grooving tools and installation of product. Documentation of installing contractor training with manufacturer's representative shall be submitted to the Architect/Engineer.
    - 2) Job Site Visitation: Manufacturer's representative shall periodically visit job site to ensure manufacturer™™s installation practices are being followed.
  - b. Extended 5-Year Product Warranty: Manufacturer shall provide extended 5-year warranty to replace product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.
  - c. Extended 5-Year Product and Installation Warranty: Manufacturer shall provide extended 5-year warranty to replace product and any part of the system damaged as a direct result of a failure of the product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.
6. Acceptable Manufacturers: Victaulic, Gruvlok, or Star Fittings.
- F. Mechanical Press Connection (Copper):
1. Copper press fitting shall be made in accordance with the manufacturer's installation instructions.
  2. Fully insert tubing into the fitting and mark tubing.
  3. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.
  4. Joint shall be pressed with a tool approved by the manufacturer. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

**END OF SECTION**



**SECTION 23 21 16  
HYDRONIC SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Air Vents
- B. Balancing Valves

**1.2 QUALITY ASSURANCE**

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

**1.3 REFERENCES**

- A. ASME - Boiler and Pressure Vessel Code.
- B. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- C. ASME B31.9 - Building Services Piping.
- D. ASME Section 9 - Welding and Brazing Qualifications.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings
- F. ASTM B32 - Standard Specification for Solder Metal.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

**1.5 COORDINATION DRAWINGS**

- A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

**PART 2 - PRODUCTS**

**2.1 AIR VENTS**

- A. At end of main and other points where large volume of air may be trapped, use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- B. On branch lines and small heating units, use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

**2.2 BALANCING VALVE**

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units that sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:
  - 1. Carrying case with handle.
  - 2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.
  - 3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.
- D. Valves in copper piping shall be brass or bronze.
  - 1. Quarter-Turn Ball Valve Style (Brass or Bronze):
    - a. Manufacturers:
      - 1) Bell & Gossett "Circuit Setter Plus"
  - 2. Quarter-Turn Venturi Style (Brass or Bronze):

- a. Manufacturers:
  - 1) Presso "B+"
  - 2) Griswold "Quickset"
  - 3) Gerand "BALVALVE Venturi"
  - 4) HCI "Terminator B"
  - 5) Nexus Valve "UltraXB Orturi"
  - 6) IMI Hydronic Engineering "Accusetter"
- 3. Multi-Turn Style (Brass or Bronze):
  - a. Manufacturers:
    - 1) Tour&Anderson (STAD)
    - 2) Armstrong "CBV"
    - 3) Victaulic 786
    - 4) Macon STVL/STV
    - 5) MEPCO MBV
    - 6) Wheatly GS
    - 7) NIBCO 1710
    - 8) RWV 951
- E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 23 09 00 with a specified throttling valve.
  - 1. Quarter-Turn Ball Valve Style (Ferrous Piping ä? 2"):
    - a. Manufacturers:
      - 1) Bell & Gossett "Circuit Setter Plus"
  - 2. Quarter-Turn Venturi Style (Ferrous Piping ä? 2"):
    - a. Manufacturers:
      - 1) Presso "B+"
      - 2) Gerand "BALVALVE Venturi"
      - 3) HCI "Terminator B"
      - 4) Nexus Valve "UltraXB Orturi"
      - 5) IMI Hydronic Engineering "Accusetter"
  - 3. Multi-Turn Style (Ferrous Piping ä? 2"):
    - a. Manufacturers:
      - 1) TA Hydraulics "786-789"
      - 2) Armstrong "CBV"
      - 3) Victaulic 787
      - 4) Macon STVL/STV
      - 5) MEPCO MBV
      - 6) Wheatly GSNIBCO 1710 (T1710L)
      - 7) RWV 951
- F. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Valves/Fittings and Accessories:
  - 1. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.
  - 2. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.

Product	Upstream Diameters	Downstream Diameters
Griswald "Quickset"	0	0
Fluid Design "Accusetter"	0 up to 2" size	0
	5 for larger sizes	

Presso "B+"	5	2
Taco "Accu-flo"	10	5
TA Hydronics 786-789	5 after fittings	2
	10 after pumps	
Bell & Gossett "Circuit Setter Plus"	3	1
Bell & Gossett "Circuit Setter"	3 up to 4" size	<b>1 up to 4" size</b>
	5 above 4" size	2 above 4" size
Armstrong "CVB" and "CVB-II"	10	5
Gerand "BALVALVE Venturi"	5	2
NIBCO 1710/737	5	3

3. Prepare accessories for finish painting.
4. Install accessories with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
5. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
6. Provide flanges or unions at all final connections to equipment, traps and valves.
7. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

**END OF SECTION**





**SECTION 23 21 23  
HVAC PUMPS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. All pumps except where integral with a manufactured piece of equipment.
- B. Pump controls where self-contained.

**1.2 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Submit motor data indicating compliance with Section 23 05 13.
- D. Submit certification that pumps, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**PART 2 - PRODUCTS**

**2.1 PUMPS - GENERAL**

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pumps shall operate at 1750 RPM unless specified otherwise.
- D. Pump connections shall be flanged, whenever available.
- E. Heating pumps shall be suitable for 225°F water.
- F. Motors shall comply with Section 23 05 13 including, but not limited to:
  - 1. Single phase motors less than 1 HP shall be electronically commutated or shall have a minimum motor efficiency of 70%.
  - 2. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service.
  - 3. All 480 volt motors driven by VFDs shall be provided with shaft grounding rings or grounding brushes or ceramic bearings as a means to protect bearings from adverse shaft currents.
- G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.
- H. Pumps specified in this section operating in clean water with a flow greater than 25 GPM and less than 459 feet head shall have a maximum Pump Energy Index (PEI) as scheduled on the drawings. In no case shall the PEI exceed 1.0.

**2.2 IN-LINE PUMP**

- A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.
- B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.
- C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.
- D. Shaft: Steel or stainless steel.
- E. Seals: Mechanical type rated for -20 to 250°F with EPR or EPT bellows and seat gasket, carbon primary ring, and silicon-carbide stationary ring.
- F. Manufacturers:
  - 1. Bell & Gossett

2. Taco
3. Aurora
4. Armstrong
5. Grundfos/Peerless/PACO
6. Patterson
7. Weinman/Crane

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General Installation Requirements:
  1. Install all products per manufacturer's recommendations.
  2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18" clearance for removal of suction diffuser.
  3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
  4. Install on vibration isolators as scheduled on drawings.
  5. Where electronically commutated motors are equipped with manual speed adjustment, pump speed shall be adjusted during the testing, adjusting, and balancing phase to achieve scheduled performance.
- B. In-Line Pumps:
  1. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
  2. Pump orientation shall be in accordance with the manufacturer<sup>TM</sup> <sup>TM</sup>s recommendations.

**END OF SECTION**

**SECTION 23 31 00  
DUCTWORK**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Galvanized Ductwork
- B. Aluminum Ductwork
- C. Stainless Steel Ductwork
- D. Exposed Ductwork (Rectangular, Round, or Oval)
- E. Flexible Duct
- F. Fume Exhaust Duct
- G. Ductwork Penetrations

**1.2 REFERENCES: Conform to all applicable requirements of the following publications:**

- A. ADC Flexible Duct Performance and Installation Standards, 3<sup>rd</sup> Edition 1996.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.
- D. ASHRAE - Handbook 2012 Systems and Equipment; Chapter 19 - Duct Construction.
- E. ASHRAE - Handbook 2013 Fundamentals; Chapter 21 - Duct Design.
- F. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- G. ASTM A90 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- H. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.
- I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- K. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- L. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- M. ASTM E413-87 - Classification for Rating Sound Insulation.
- N. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.
- O. AWS D9.1M/D9.1 - Sheet Metal Welding Code.
- P. IECC - International Energy Conservation Code (latest published edition)
- Q. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- R. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
- S. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.
- T. SMACNA - Air Duct Leakage Test Manual.
- U. SMACNA - HVAC Duct Construction Standards.
- V. SMACNA - Phenolic Duct Construction Standard 022.
- W. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.
- X. UL 181 - Factory-Made Air Ducts and Air Connectors.
- Y. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors
- Z. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.
- AA. UL 1978 - Standard for Grease Ducts.
- BB. UL 2221 - Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies.

**1.3 DEFINITIONS**

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.
- C. Exterior Duct: Ductwork located outside the conditioned envelope including exposed ductwork above the roof, outside exterior walls, in attics above insulated ceilings, inside parking garages, and crawl spaces.

- D. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS AND SUPPORTS**

A. Rectangular Duct - Single Wall:

1. General Requirements:

- a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
- b. Transitions shall not exceed the angles in Figure 4-7.

2. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

- a. All ducts shall be cross-broken or beaded.
- b. Snap lock seams are not permitted.
- c. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

1) Type 1:

- a) Description: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
- b) Usage: Limited to 3,000 fpm and vane lengths 36" and under.

2) Type 2:

- a) Description: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
- b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

3) Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):

- a) Description: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.
- b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.

4) Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

5) Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

6) Omitting every other vane is prohibited.

- d. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Mitered elbows (with or without turning vanes) may not be substituted for radius elbows. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

- e. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
- f. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.
- g. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.
- h. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
- i. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
- j. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.
- k. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
  - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
  - 2) Manufacturers:
    - a) Ductmate Industries - 25/35/45
    - b) Nexus
    - c) Mez
    - d) WDCI
    - e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.
- l. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
  - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
  - 2) Flanges shall be 24-gauge minimum (not 26 gauge).
  - 3) Manufacturers:
    - a) Lockformer TDC
    - b) TDF
    - c) United McGill
    - d) Sheet Metal Connectors
    - e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.
  2. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
  3. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
  4. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
  5. Ductwork shall be suitable for velocities up to 5,000 fpm.
  6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
  7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
  8. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
  9. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
  10. Transverse Joint Connections:
    - a. Crimped joints are not permitted.
    - b. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
    - c. Ducts and fittings larger than 36" shall have flanged connections.
    - d. Secure all joints with at least 3 sheet metal screws before sealing.
    - e. Manufacturers, Slide-on Flanges:
      - 1) Ductmate Industries - SpiralMate
      - 2) Accuflange
      - 3) Sheet Metal Connectors are acceptable.
    - f. Manufacturers, Self-Sealing Duct Systems:
      - 1) Lindab
      - 2) Ward "Keating Coupling"
- C. Round Snap-Lock Seam Ductwork - Single Wall:
1. Factory sealed snap-lock pipe. Transverse and longitudinal seams shall contain factory-applied self-sealing EPDM and co-polymer gasket. Snap-lock shall conform to SMACNA RL-8. Duct and gasket material shall meet the flame/smoke spread rating of 25/50 per ASTM-E84.
  2. G-60 galvanized coating meeting ASTM A653 and ASTM A90 G-90 galvanized steel aluminum meeting ASTM B209 Alloy 3003 Temper H14 304 stainless steel meeting ASTM A480 2B Finish.
  3. Snap-lock seams are only permitted on systems between -1"w.c. and 2"w.c. pressure class.
  4. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
  5. Duct and fittings shall meet the required minimum gauges listed in Chapter 3 of the SMACNA requirements for the specified pressure class.
  6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
8. Manufacturers:
  - a. GreenSeam Industries.
- D. Hangers and Supports General Requirements:
  1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
  2. Strap Hangers: Strap hanger shall be a minimum of 1 inch, 18 gauge attached to the bottom of ducts with spacing as required by SMACNA.
  3. Cable Hangers:
    - a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.
    - b. Manufacturers; Supports:
      - 1) Gripple
      - 2) Ductmate
      - 3) Duro Dyne
      - 4) Architect/Engineer approved
    - c. Aircraft cable with 2-point support in standard horseshoe arrangement. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. 8'-0" OC and as required by CMC/UMC and SMACNA guidelines.
  4. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs.. Install per manufacturer's ratings and instructions.
    - a. Manufacturers; Supports:
      - 1) EZ Hanger

## **2.2 MATERIAL AND APPLICATION SPECIFIC**

- A. Galvanized Steel:
  1. General Requirements:
    - a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
    - b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
    - c. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
    - d. Ductwork reinforcement shall be of galvanized steel.
  2. Duct Hangers and Support Material:
    - a. Ductwork hangers and supports shall be of galvanized or painted steel.
    - b. All fasteners shall be galvanized or cadmium plated.
- B. Aluminum Ductwork:
  1. General Requirements:
    - a. Material: ASTM B209; aluminum sheet, Alloy 3003-H14. Aluminum connectors and bar stock: Alloy 6061-T6. Aluminum or stainless steel fasteners are acceptable.
    - b. All duct gauges and reinforcement shall be as called for in Tables 2-50, 2-51, 2-52, and 3-14 of the SMACNA HVAC Duct Construction Standards.
    - c. Ductwork reinforcement shall be of aluminum.
  2. Duct Hangers and Supports Material:
    - a. Ductwork hangers and supports shall be of aluminum. Slip cable hangers are acceptable if constructed of aluminum.
    - b. All fasteners shall be aluminum.

- C. Stainless Steel Ductwork:
  - 1. General Requirements:
    - a. Ductwork shall be Type 304L stainless steel, 16 gauge minimum.
    - b. Ductwork shall be Type 316L stainless steel, 16 gauge minimum.
    - c. Exposed ductwork shall have a #3 finish. Concealed ductwork may have milled finish.
    - d. Ductwork reinforcement shall be of stainless steel.
  - 2. Duct Hangers and Supports Material:
    - a. Ductwork hangers and supports shall be of stainless steel. Slip cable hangers are acceptable if constructed of stainless steel.
    - b. All fasteners shall be stainless steel or cadmium plated steel.
- D. Exposed Ductwork (Rectangular, Round, and Flat Oval):
  - 1. The following applies to all ductwork exposed in finished areas in addition to requirements noted above:
    - a. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.
    - b. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.
    - c. Remove all identification stickers and thoroughly clean exterior of all ducts.
    - d. Locate fitting seams on least visible side of duct.
    - e. Provide exterior finish suitable for field painting without further oil removal.
    - f. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct.
    - g. Manufacturers, Slide-on Flanges:
      - 1) Ductmate Industries
      - 2) Accuflange
      - 3) Sheet Metal Connectors
    - h. Manufacturers, Self-Sealing Duct System:
      - 1) Lindab
      - 2) Ward "Keating Koupling"
    - i. The system shall be free of visible dents and scratches when viewed from normal occupancy.
    - j. All insulation shall be internal, except at reheat coils.
  - 2. In addition to the paragraphs above, this section applies to all ductwork specified or shown as "Architecturally Exposed":
    - a. All spiral ductwork fittings shall be carbon arc welded.
    - b. Grind all welds to remove irregularities.
    - c. Conical taps shall be one piece. Taps for grilles and takeoffs shall be factory installed with a continuous weld and ground smooth.
    - d. Welds shall be ground smooth and painted.
    - e. All architecturally exposed ducts shall be round or flat oval except where not possible (grilles, reheat coils, etc.).
  - 3. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:
    - a. Metal gauge of duct and fittings.
    - b. Fitting type and construction.
    - c. Type and size of reinforcement.
  - 4. Hangers for Exposed Ductwork:
    - a. Round Ducts:
      - 1) Threaded rod with duct fixing bracket and metal strap. Provide single threaded rod centered on the duct. Strap hanger shall be a minimum of 1 inch, 18 gauge galvanized steel wrapping the circumference of the duct. Spacing as required by SMACNA guidelines.



- 2) Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Spacing and cable size as required by SMACNA guidelines.
    - a) Manufacturers, Supports: Gripple, Ductmate, Duro Dyne, Architect/Engineer approved.
  - 3) Aircraft cable with 2-point support in standard horseshoe arrangement. Spacing and cable size as required by SMACNA guidelines.
  - b. Rectangular Ducts:
    - 1) Aircraft cable and slip cable hangers are acceptable for ducts up to 18" in maximum dimension. Corner saddles are required when supporting rectangular ductwork. Spacing and cable size as required by SMACNA guidelines.
      - a) Manufacturers, Supports: Gripple, Ductmate, Duro Dyne, Architect/Engineer approved.
    - 2) Aircraft cable with 2-point support in standard horseshoe arrangement. Corner saddles are required when supporting rectangular ductwork. Spacing and cable size as required by SMACNA guidelines.
  - c. Strut-channel and all-thread rod is not acceptable for exposed ductwork.
  - d. All fasteners shall be galvanized or cadmium plated.
- E. Fume Exhaust Duct:
1. Stainless Steel:
    - a. Unless shown otherwise on the drawings, all fume exhaust ductwork shall be 14 gauge Type 304L stainless steel with continuously welded joints. Ductwork shall meet all requirements of SMACNA Class 5-6" pressure class industrial ductwork. Use heavier gauge and/or transverse reinforcements if required.
    - b. Elbows up to 30° shall be mitered two-piece type. Elbows 31° to 50° shall be mitered three-piece type. Elbows 51° to 90° shall be mitered five-piece type. All elbows shall have a minimum centerline R/D of 1.5. Elbows 10" in diameter and smaller may be die-formed.
    - c. Expanders in horizontal ducts shall be eccentric type with a minimum length of (diameter change x 10) and shall maintain a positive pitch for drainage to the fume hood or exhaust outlet. Expanders in ducts over 30° from horizontal shall be concentric with a minimum length of (diameter change x 5).
    - d. Ducts shall maintain the maximum possible pitch toward their inlets unless a different drainage location is indicated on the drawings. If at least 1/8" per foot pitch cannot be maintained, notify the Architect/Engineer before installing ductwork or other items with which ductwork may conflict.
    - e. All welds shall conform to AWS D9.1M. Welds shall be Gas Tungsten Arc Weld (TIG) or Gas Metal Arc Weld (MIG) type. All filler metal shall conform to AWS A5.9 or A5.22 and be AWS Classification ER308L or ER308LSi with a carbon content of not over 0.03%.
    - f. Supports shall not penetrate duct surfaces. Ductwork shall be completely leak-tight from the inlet to the discharge to the atmosphere, at pressures up to 10" WG. Install caps to seal the ductwork for pressure testing. Plug all spray and drain connections when testing ductwork.
    - g. Where flanged joints are indicated, they shall have 1/4" "Gore-Tex Joint Sealant" gaskets (W. L. Gore & Associates, Industrial Products Division, 100 Airport Road, Box 1550, Elkton, MD 21921 (410) 392-4440 or (410) 392-3200). PTFE gaskets are also acceptable.

- h. All ducts indicated as "316SS" shall be constructed of Type 316L stainless steel. The specification above for 304L stainless steel ductwork also applies to 316L stainless steel ductwork except all filler metal shall be AWS Classification ER316L with a carbon content of not over 0.03%.
- i. Do not penetrate fire rated partitions, unless protected as required by applicable codes.

### 2.3 DUCTWORK SEALANTS

- A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.
- B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.
- C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.
- D. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F.
  - 1. Manufacturers, Pressure-Sensitive Tape:
    - a. Venture Tape 1581A
    - b. Compac #340
    - c. Scotch Foil Tape 3326
    - d. Polyken 339

### 2.4 FLEXIBLE DUCT

- A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.
- B. Flame Spread/Smoke Developed: Not over 25/50.
- C. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.
- D. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.
- E. Acoustic:
  - 1. Flexible duct shall be acoustic rated in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL. Insertion loss values noted below are for flow velocities less than 2,500 fpm. Submittals shall include insertion losses ratings per sizes and lengths listed below regardless of sizes shown on the drawings.
  - 2. Flexible have corrosion-resistant wire helix, bonded to a nylon fabric core inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh. Usage: All areas unless noted otherwise.

3. Inner liner shall be airtight and suitable for 6" WC static pressure through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft<sup>2</sup>\*F\*hr/Btuh. Temperature range of at least 0-180°F. Maximum velocity of 4,000 fpm. "R" value shall not be less than 4.0 ft<sup>2</sup>\*F\*hr/Btuh. Ducts in unconditioned spaces and ventilated attics: "R" value shall not be less than 6.0 ft<sup>2</sup>\*F\*hr/Btuh.
4. Usage:
  - a. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
  - b. Connections to air inlets and outlets. Do not exceed 5'-0" in length.
  - c. Acceptable Manufacturers:
    - 1) Flexmaster USA - Type 6
    - 2) Thermaflex M-Ke
- F. Radius Forming Elbows:
  1. Flexible plastic radius forming elbow for use with flexible ducts to create 90deg elbow. One size for 6" to 16" diameter ducts. UL listed for return plenum spaces.
  2. Usage: All supply air terminals with flexible ductwork connection.
  3. Installation: Attach to flex duct and secure draw bands without crushing flex duct to form smooth radius elbow. Suspend radius forming elbow to structure. Install per manufacturer's instructions.
  4. Acceptable Manufacturers:
    - a. Hart & Cooley - Smartflow
    - b. Thermaflex - Flexflow
    - c. Titus - Flexright

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.
- D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.
- E. Supply ductwork shall be free of construction debris, and shall comply with Level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- F. Repair all duct insulation and liner tears.
- G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.
- H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.
- L. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

### 3.2 DUCTWORK APPLICATION SCHEDULE

- A. General:
  - 1. Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual
  - 2. Insulation:
    - a. Refer to Section 23 07 13 for insulation types.
    - b. Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression).
  - 3. Note 1: Apply aluminum based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant.
  - 4. Note 2: Apply aluminum based adhesive sealant tape on TAB boxes (all seams and joints of the box and duct connections) serving dedicated outside air supply (DOAS) system.
- B. Supply Duct from Fan to Terminal Air Boxes - Single Wall:
  - 1. Shape:
    - a. Rectangular Duct - Single Wall
    - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall
  - 2. Material: Galvanized Steel
  - 3. Pressure Class: +3"
  - 4. Seal Class: A
  - 5. Insulation:
    - a. ASHRAE 90.1-2019: 1-1/2" thick Type A (R=4.5)
    - b. IECC-2021: 1-1/2" thick Type A (R=4.5)
  - 6. Additional Requirements: None
- C. Supply Duct from Fan to Terminal Air Boxes:
  - 1. Shape:
    - a. Rectangular Duct - Single Wall
    - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall
  - 2. Material: Galvanized Steel
  - 3. Pressure Class: +3"
  - 4. Seal Class: A
  - 5. Insulation:
    - a. ASHRAE 90.1-2019: 1-1/2" thick Type A (R=4.5)
    - b. IECC-2021: 1-1/2" thick Type A (R=4.5)
  - 6. Additional Requirements: Provide all with slide-on flange system or formed-on flanges.
- D. Supply Duct from Terminal Air Boxes to Outlets:
  - 1. Material: Galvanized Steel
  - 2. Pressure Class: +2"
  - 3. Seal Class: A
  - 4. Insulation:
    - a. ASHRAE 90.1-2019: 1-1/2" thick Type A (R=4.5)
    - b. IECC-2021: 1-1/2" thick Type A (R=4.5)
  - 5. Additional Requirements: None
- E. Return Duct:
  - 1. Material: Galvanized Steel
  - 2. Pressure Class: -2"
  - 3. Seal Class: A
  - 4. Insulation:
    - a. ASHRAE 90.1-2019: None
  - 5. Additional Requirements: None
- F. General Exhaust Duct:
  - 1. Material: Galvanized Steel
  - 2. Pressure Class: -1"
  - 3. Seal Class: A
  - 4. Insulation: None

5. Additional Requirements: None
- G. Fume Exhaust Duct:
  1. Shape: Refer to "Fume Exhaust Duct"
  2. Material: Stainless Steel
  3. Pressure Class: -2
  4. Seal Class: A
  5. Insulation: 1-1/2" thick Type A (R=4.5) within 15' of penetration of exterior wall or roof
- H. Transfer Ducts:
  1. Material: Galvanized Steel
  2. Pressure Class: -1/2"
  3. Insulation: 1" thick Type C (R=3.6)
- I. Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.):
  1. Insulation:
    - a. ASHRAE 90.1-2019: 1-1/2" thick Type A (R=4.5)
    - b. IECC-2021: 1-1/2" thick Type A (R=4.5)
- J. All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers:
  1. Insulation: 1-1/2" thick Type A (R=4.5)

### 3.3 DUCTWORK SEALING

- A. General Requirements:
  1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
  2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
  3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
  4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.
- B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.
- C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

### 3.4 TESTING

- A. Interior Duct - 3" WG and Above (positive or negative):
  1. A minimum of 25% of interior ductwork (inside the building envelope) shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.
  2. Duct system shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.
  3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
  4. Seal ducts to bring the air leakage into compliance.
  5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.
- B. Exterior Duct - 1/2" WG and Above (positive or negative):
  1. All exterior ductwork (outside the building envelope) shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.

2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:
  - a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
  - b. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
  - c. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
  - d. All joints shall be felt by hand, and all discernible leaks shall be sealed.
  - e. Totalling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
  - f. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
  - g. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
  - h. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
  - i. Positive pressure leakage testing is acceptable for negative pressure ductwork.

D. Fume Exhaust Duct:

1. Testing shall be done before any exterior insulation is applied.
2. Cap each exhaust system at all inlets and at the discharge to atmosphere. Fans, dampers and flexible connections shall be included in the testing.
3. Pressurize each duct system to 7" water column. Leakage shall not exceed 4 cfm regardless of system size.
4. Where several fans discharge into a large collection duct, the collection duct and each individual exhaust duct may be treated as separate systems.

**3.5 DUCTWORK PENETRATIONS**

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.
- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

**END OF SECTION**

**SECTION 23 33 00**  
**DUCTWORK ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Manual Volume Dampers.
- B. Backdraft Dampers.
- C. Fabric Connectors.
- D. Duct Access Doors.
- E. Duct Test Holes.

**1.2 REFERENCES**

- A. AMCA Guide for Commissioning and Periodic Performance Testing of Fire, Smoke and Other Life Safety Related Dampers.
- B. ASTM E477-06a - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- C. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- D. NFPA 72 - National Fire Alarm and Signaling Code
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- F. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- G. NFPA 92 - Standard for Smoke Control Systems.
- H. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.
- I. SMACNA - HVAC Duct Construction Standards (latest edition).
- J. UL 33 - Heat Responsive Links for Fire-Protection Service.
- K. UL 555 - Fire Dampers and Ceiling Dampers.
- L. UL 555C - Ceiling Dampers.
- M. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.
- N. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit manufacturer's installation instructions.
- C. Include UL ratings, California State Fire Marshal approval and NFPA 90A, dynamic ratings, leakage, pressure drop and maximum pressure data.
- D. Submit certification that ductwork accessories will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Manufacturer shall provide special seismic certification per HCAI CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.

**PART 2 - PRODUCTS**

**2.1 MANUAL VOLUME DAMPERS**

- A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.
- B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.
- E. Provide locking quadrant regulators on single and multi-blade dampers.
- F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

## **2.2 BACKDRAFT DAMPERS**

- A. Gravity backdraft dampers, size 18 inches x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90° stop, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- C. Models:
  - 1. Ruskin CBD4
  - 2. Arrow 655
  - 3. Safe-Air/Dowco BRL
  - 4. Greenheck EM.

## **2.3 FABRIC CONNECTORS**

- A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.
- B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.
- C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalis, grease and gasoline, and shall be noncombustible.
- D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.
- E. All corners shall be folded, sealed with mastic and stapled on 1" centers.
- F. Fabric connectors shall not be painted.
- G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.
- H. Materials:
  - 1. Durodyne MFN-4-100
  - 2. Vent Fabrics, Inc.
  - 3. "Ventglas"
  - 4. Proflex PFC3NGA
- I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.
- J. Materials:
  - 1. Durodyne "Duralon MFD-4-100"
  - 2. Vent Fabrics, Inc.
  - 3. "Ventlon"
  - 4. Proflex PFC3HGA

## **2.4 DUCT ACCESS DOORS**

- A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.



- B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.
- C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- D. Access doors with sheet metal screw fasteners are not acceptable.
- E. Minimum size for access doors shall be 24" x 16" or full duct size, whichever is less.
- F. Provide duct access door in all horizontal return ductwork at 20 foot intervals per NFPA 90A.
- G. Fire Damper, Fire/Smoke Damper Access Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. For ducts larger than 12x12 , provide one access door. For ducts 12" x 12" and smaller, provide one access door on bottom and one on side.

## **2.5 DUCT TEST HOLES**

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

## **2.6 DUCTWORK ACCESSORY SEALANTS**

- A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.
- B. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General Installation Requirements:
  - 1. Install accessories in accordance with manufacturer's instructions.
  - 2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
  - 3. Coordinate and install access doors provided by others.
  - 4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
  - 5. Provide duct test holes where indicated and as required for testing and balancing purposes.
- B. Manual Volume Damper:
  - 1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
  - 2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.
  - 3. Grease duct volume dampers shall be continuously welded to duct and/or hoods so that system is liquidtight.

**END OF SECTION**



**SECTION 23 34 16  
CENTRIFUGAL FANS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fume Exhaust Fans.
- B. Fabrication: Conform to AMCA 99.

**1.2 REFERENCES**

- A. AMCA 99 - Standards Handbook.
- B. AMCA 208 - Calculation of the Fan Energy Index (FEI).
- C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- H. SMACNA - HVAC Duct Construction Standards (latest edition).

**1.3 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include data on all fans and accessories. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point.
- B. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement, and spare parts list.
- C. Submit certification that centrifugal fans, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**1.4 EXTRA STOCK**

- A. Provide one extra belt set for each fan unit.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors, shafts, and bearings from weather and construction dust.

**PART 2 - PRODUCTS**

**2.1 ROOF-MOUNTED FUME FAN ASSEMBLY**

- A. Fan Description: Single inlet, single width. backward inclined wheel, with factory stack extension, factory mounted inlet box, mounted to a single curb cab. Suitable for ambient temperatures from -40°F to +120°F. Wind rated for 115mph.
- B. Construction:
  - 1. Wheel: Wheel shall be steel centrifugal backward inclined, non-overloading flat blade type. Blades shall be continuously welded to the backplate and inlet shroud. Wheel hub shall be keyed and securely attached to the motor shaft.
  - 2. Housing: Heavy gauge steel all welded construction (14 gauge min. sides), adaptable to any of 8 discharge positions in the field.
  - 3. Stack Extension: Integral, self-supported stack for a minimum of 10ft discharge above the roof.
  - 4. Drive: Arrangement 10 belt drive with motor below shaft. Adjustable pitch sheaves with the specified operating point in the center of adjustment range. Sized for minimum 1.2 of motor horsepower (power), or Arrangement 4 direct drive..

5. Support: Steel or aluminum mounting frame with baked enamel finish.
  6. Protection: Heavy-duty gas-tight shaft seals. All surfaces in contact with the airstream shall be cleaned with solvent equal to Heresite 330 and given three 2 mil minimum thickness coats of [air dried phenolic equal to Heresite VR-500][baked phenolic equal to Heresite P-403]. Coat entire face of all flanges and entire length of inlet collars on both sides.
- C. Protection:
1. Belt guards with tachometer knockouts on indoor fans. Removable weather covers on outdoor fans.
- D. Motor (as scheduled on the drawings):
1. Induction: Furnish externally mounted open drip-proof, ball bearing motor[, with adjustable mounts for belt tightening]. Refer to motor specification for motor requirements.
    - a. Disconnect provided by Electrical Contractor, wired in the field.
  2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48. All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:
    - a. ECM set for constant CFM.
    - b. ECM modulating control using 0-10Vdc modulating signal.
    - c. ECM set for constant pressure.
- E. Roof Mounting Curb: Curb height as shown on drawings, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.
- F. Curb Cap and Inlet Box: Fully welded seams and corners, gasketed access door, and under curb duct drop with matching flange and field duct connection.
- G. Bearings: Regreasable, rated for 40,000 hour B-10 life at specified operating point.
- H. Manufacturers:
1. Greenheck FJ
  2. Cook CPS

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General Installation Requirements:
1. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.
  2. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
  3. Install flexible connections between fan and ductwork. Install metal bands of connectors parallel with minimum 1" flex between ductwork and fan while running.
  4. Provide safety screen where inlet or outlet is exposed. Screens shall meet OSHA regulations for size of openings.
- B. Fume Exhaust Fan:
1. Each fume exhaust fan shall have a 3/8" diameter hole drilled in one of its base rails for electrical grounding. Scrape away paint near the hole for good grounding.

**END OF SECTION**

**SECTION 23 34 23**  
**POWER VENTILATORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Roof Exhaust Fan.
- B. Rooftop Exhaust Fan - Vertical Discharge - Belt Driven.
- C. In-Line Cabinet Fan.

**1.2 QUALITY ASSURANCE**

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300.
- C. Fabrication: Conform to AMCA 99.
- D. Fan Energy Index (FEI): Fans shall meet or exceed the minimum FEI scheduled at the specified airflow, pressure, and air density (duty point). In no case shall the FEI at the specified duty point fall below [1.0][1.1].

**1.3 REFERENCES**

- A. AMCA 99 - Standards Handbook.
- B. AMCA 208 - Calculation of the Fan Energy Index (FEI).
- C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 230 - AMCA 230 - Laboratory Methods of Testing Air Circulating Fans for Rating and Certification.
- E. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- F. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- G. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- H. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- I. SMACNA - HVAC Duct Construction Standards (latest edition).

**1.4 SUBMITTALS**

- A. Submit shop drawings per Section 23 05 00. Include data on all fans and accessories. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point (ceiling and HVLS fans are exempt from FEI submittal requirements).
- B. Submit manufacturer's installation instructions.
- C. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- D. Submit certification that power ventilators, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**1.5 EXTRA STOCK**

- A. Provide one (1) extra belt set for each fan unit.

**PART 2 - PRODUCTS**

**2.1 ROOFTOP EXHAUST FAN - BELT DRIVEN**

- A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backward inclined blades, statically and dynamically balanced.
- B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.
- C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.

- D. Any steel parts shall be galvanized or epoxy coated. Non-corrosive fasteners.
- E. V-belt drive with adjustable pitch drive sheave and adjustable motor mountings for belt tensioning.
- F. Motor mounted outside of airstream and ventilated with outside air. Motor not less than 1/3 HP.
- G. Aluminum or brass bird screen. Plastic mesh will not be allowed.
- H. Mill aluminum finish.
- I. Dampers: Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs. Damper shall be aluminum with brass bushings, blade seals, and blade tie rods. Leakage shall not exceed 4 cfm/sq.ft @1" SP (or shall be AMCA Class 1 certified).
- J. Motor (as scheduled on drawings):
  - 1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.
    - a. Disconnect as scheduled on drawings.
    - b. Provide non-fused, factory mounted and wired disconnect switch mounted inside fan housing.
    - c. Disconnect provided by Electrical Contractor, wired in the field.
  - 2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:
    - a. ECM set for constant CFM.
    - b. ECM modulating control using 0-10Vdc modulating signal.
    - c. ECM set for constant pressure.
- K. Speed Controller: For single phase induction motor fans, furnish solid-state dial speed controller. Mount and wire inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.
- L. Bearings:
  - 1. Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 2. Furnish permanently lubricated sealed ball type motor and drive shaft bearings sized for 200,000 hours life at specified operating conditions. Drives sized for 150% of rated motor horsepower. Drive assembly and wheel supported by vibration isolators.
- M. Manufacturers:
  - 1. Aerovent
  - 2. Greenheck
  - 3. Cook
  - 4. Carnes
  - 5. PennBarry
  - 6. ACME
  - 7. ILG
  - 8. Jenco
  - 9. Soler-Palau
  - 10. York
- N. Manufacturers:
  - 1. Aerovent "FACX"
  - 2. Cook "ACE-B"
  - 3. Greenheck "GB"

4. Carnes "VEB"
5. PennBarry DX
6. ACME PV
7. ILG CRB
8. Twin City BCRD
9. York

## 2.2 ROOFTOP EXHAUST FAN - DIRECT DRIVEN

- A. Fan Wheel: Centrifugal type, aluminum or composite with backward inclined or airfoil blades, statically and dynamically balanced.
- B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.
- C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.
- D. Any steel parts shall be galvanized or epoxy coated. Non-corrosive fasteners.
- E. Direct drive, motor mounted outside of airstream and ventilated with outside air.
- F. Aluminum or brass bird screen. Plastic mesh will not be allowed.
- G. Mill aluminum finish.
- H. Dampers: Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs. Dampers shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq.ft @1" SP (or shall be AMCA Class 1 certified).
- I. Motor (as scheduled on drawings):
  1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.
    - a. Disconnect as scheduled on drawings.
    - b. Provide non-fused, factory mounted and wired disconnect switch mounted inside fan housing.
    - c. Disconnect provided by Electrical Contractor, wired in the field.
  2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:
    - a. ECM set for constant CFM.
    - b. ECM modulating control using 0-10Vdc modulating signal.
    - c. ECM set for constant pressure.
- J. Speed Controller: For single phase induction motor fans, furnish solid-state dial speed controller. Mount and wire inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.
- K. Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
- L. Manufacturers:
  1. Aerovent "FACX"
  2. Cook "ACE-D"
  3. Greenheck
  4. ILG - CRD
  5. ACME PX
  6. PennBarry DX
  7. Carnes
  8. Twin City DCRU
  9. Jenco
  10. Soler-Palau

11. York

**2.3 ROOFTOP EXHAUST FAN - VERTICAL DISCHARGE - BELT DRIVEN**

- A. Fan Wheel: Centrifugal type, aluminum hub and wheel with backwards inclined blades, statically and dynamically balanced.
- B. Housing: Removable, spun aluminum dome or rectangular top, with square, one piece, aluminum base and curb cap with Venturi inlet cone.
- C. Fan Shaft: Turned, ground and polished steel; keyed to wheel hub.
- D. V-belt drive with adjustable pitch drive sheave and adjustable motor mountings for belt tensioning.
- E. Motor mounted outside of airstream and ventilated with outside air. Motor not less than 1/3 HP.
- F. Aluminum or brass bird screen. Plastic mesh will not be allowed.
- G. Mill aluminum finish.
- H. Dampers: Furnish normally closed, electric motorized damper. Provide step-down transformer if required. Install and wire damper to open when fan runs. Damper shall be aluminum with brass bushings, blade seals and blade tie rods. Leakage shall not exceed 4 cfm/sq.ft @1" SP (or shall be AMCA Class 1 certified).
- I. Motor (as scheduled on drawings):
  - 1. Induction: Furnish permanently lubricated sealed ball type motor and drive shaft bearings. Motor and wheel supported by vibration isolators.
    - a. Disconnect as scheduled on drawings.
    - b. Provide non-fused, factory mounted and wired disconnect switch mounted inside fan housing.
    - c. Disconnect provided by Electrical Contractor, wired in the field.
  - 2. Electronically Commutated Motor (ECM): Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall include integral surge protection. Motor shall be pre-wired for specific voltage and phase. Motor frame shall be NEMA 48; All EC motors shall be a minimum of 85% efficient at all speeds. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic overcurrent protection. Provide non-fused, with thermal overload protection, factory mounted and wired disconnect switch mounted inside fan housing. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed. Operational mode shall be as follows:
    - a. ECM set for constant CFM.
    - b. ECM modulating control using 0-10Vdc modulating signal.
    - c. ECM set for constant pressure.
- J. Speed Controller: For single phase induction motor fans, furnish solid-state dial speed controller. Mount and wire inside fan unless shown otherwise on the drawings. Provide permanent marking at balanced point.
- K. Bearings:
  - 1. Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 2. Furnish permanently lubricated sealed ball type motor and drive shaft bearings sized for 200,000 hours life at specified operating conditions. Drives sized for 150% of rated motor horsepower. Drive assembly and wheel supported by vibration isolators.
- L. Manufacturers:
  - 1. ACME
  - 2. Cook
  - 3. Greenheck
  - 4. PennBarry
  - 5. Twin City
  - 6. Jenco
  - 7. Soler-Palau
  - 8. York



## 2.4 ROOFTOP FAN CURBS

- A. Furnish and install prefabricated roof curbs for all rooftop fans.
- B. Size curb to match the curb cap of fan.
- C. Roof Mounting Curb: Curb height as shown on drawings, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.
- D. Construction: Unitized construction, continuous arc welded corner seams. Insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board. Damper support angle. Pressure treated wood nailer.
  - 1. 18-gauge galvanized steel.
  - 2. 14-gauge aluminum.
- E. If called for in the drawings, curbs shall be of the sound attenuation type. Sound attenuation curbs shall reduce the fan sone rating by at least 40% and not decrease fan cfm more than 8% (which is accounted for in the scheduled fan cfm). Baffles shall be removable for access to the dampers.
- F. Manufacturers:
  - 1. Same manufacturer as the fan
  - 2. Pate
  - 3. RPS
  - 4. Thy

## 2.5 IN-LINE CABINET FAN

- A. Fiberglass lined, sheet metal housing, arranged for in-line installation.
- B. Rubber torsion motor mounts.
- C. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for fractional horsepower induction motors, with thermal overload relay, toggle operator.
- D. Built-in backdraft damper.
- E. Centrifugal fan.
- F. Provide variable speed controller if shown on the drawings.
- G. Manufacturers:
  - 1. ACME
  - 2. Broan
  - 3. Carnes
  - 4. Cook
  - 5. Jenco
  - 6. PennBarry
  - 7. Greenheck
  - 8. Soler-Palau
  - 9. York

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated lag screws to roof curb.
- C. If manufacturer has no recommendations, secure roof exhaust fans to curbs with 1/4" lag bolts on 8" maximum centers.
- D. MC shall install and wire factory provided damper to open when the fan runs if the manufacturer does not provide an option to pre-wire the damper.

## END OF SECTION



**SECTION 23 36 00  
AIR TERMINAL UNITS**

**PART 1 - GENERAL**

**1.1 REFERENCES**

- A. NFPA 70 - National Electrical Code.
- B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- C. UL 181 - Factory-Made Air Ducts and Connectors.

**1.2 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.
- D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch WG.
- E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- F. Submit manufacturer's installation instructions.
- G. Submit certification that all air terminal units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Manufacturer shall provide special seismic certification per HCAI CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.

**1.3 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.
- C. Include directions for resetting constant volume regulators.

**PART 2 - PRODUCTS**

**2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)**

- A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8" 20-lb. density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined. Acoustical considerations shall take priority over sizes noted in schedule. It is the manufacturer's responsibility to increase inlet size to meet acoustic levels scheduled.

**2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX**

- A. Casing: Minimum 22 gauge galvanized steel.
  - 1. Insulation: Insulation shall be UL listed and meet NFPA 90A requirements. Fully insulated with:
    - a. Minimum 1/2", minimum 1-1/2 pound density fiberglass insulation.
    - b. Minimum 1" foil faced liner, minimum 1-1/2 pound density fiberglass insulation.

- c. Minimum 1/2" foil faced liner, minimum 1-1/2 pound density fiberglass insulation.
  - d. 3/4" elastomeric closed cell insulation liner.
  - e. 1" double wall with 1-1/2 pound density fiberglass insulation.
  - f. Usage: All supply air systems.
2. Non-insulated.
    - a. Usage: Return air system, exhaust air system.
- B. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.
- C. Inlet Flow Sensor: Provide "cross" • • or "ring• • " style velocity and static sensor at inlet to box for use by unit controller.
- D. Damper Operators: Furnish all mounting brackets, relays, and linkages. Damper operator shall be provided as follows:
1. Pneumatic: Provided by the manufacturer and installed in the factory.
  2. Electronic: Provided by the manufacturer and installed in the factory. Operator shall be UL listed, electronic direct coupled with spring return to normal position for modulating or two-position control as noted in the sequence of control. Actuator shall be 24 VAC with proportional control, electronic overload protection to prevent actuator damage due to over-rotation and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).
  3. Electronic: Provided by the TCC and installed by the manufacturer. refer to Section 23 09 00 for additional information.
  4. Electronic: Provided and installed by the TCC in the field.
- E. Electronic Volume Regulator/Controller: Set boxes for maximum and minimum settings shown on the drawings. Electronic volume regulator/controller shall be provided as follows:
1. Provided by the manufacturer and installed in the factory.
  2. Provided by the TCC and installed by the manufacturer. Refer to Section 23 09 00 for additional information.
  3. Provided and installed by the TCC in the field.
- F. Hot Water Coils: Copper tubes, aluminum fins, minimum 0.016" wall thickness, leak tested at 300 psig. Air pressure drop shall not exceed scheduled value. Provide access door or removable panel for access to the upstream side of the heating coil. Capacity shall be as scheduled on the drawings. Hot water control valve shall be by the TCC.
- G. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings. It is the manufacturer's responsibility to increase inlet size to meet pressure drop and N.C. levels scheduled.
- H. Refer to control diagrams and notes on control drawings for complete sequence of control.
- I. Manufacturers:
1. Carrier
  2. Titus
  3. Trane
  4. Krueger
  5. Carnes
  6. E.H. Price
  7. Tuttle & Bailey
  8. Nailor
  9. Enviro-Tec
  10. Johnson Controls Inc.
  11. Metalaire.
  12. Anemostat.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National Electrical Code.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure. Do not support from adjacent ductwork.
- E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located on the side of the box away from the wall or joist to permit easy access.
- F. Comb fins on coils to repair bent fins.
- G. Insulate terminal air box hydronic reheat coils to prevent condensation. Tape insulation tight to box. Do not insulate or interfere with actuator, access panel and control panel.

**3.2 ADJUSTING**

- A. All boxes shall be set to the cfm shown on the drawings. TCC shall be responsible to field recalibrate all boxes that are not set correctly.

**END OF SECTION**



**SECTION 23 37 00**  
**AIR INLETS AND OUTLETS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Grilles And Registers.
- B. Fan Filter Units.

**1.2 QUALITY ASSURANCE**

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

**1.3 REFERENCES**

- A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.
- B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- E. SMACNA - Duct Construction Standards.

**1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 23 05 00.
- B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- D. Submit manufacturer's installation instructions.
- E. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

**1.5 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

**1.6 EXTRA STOCK**

- A. Provide clean filters in all filter return grilles at time of installation.
- B. Provide one additional set of replacement filters for all filter return grilles. Deliver to Owner at job site.

**PART 2 - PRODUCTS**

**2.1 AIR TERMINALS - GRILLES AND REGISTERS**

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.
- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- E. The capacity and size of the unit shall be as shown on the drawings.
- F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10-12 watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.
- G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

- I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.
- J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.
- K. Where specified to have filters, provide with filter rack suitable for 1" thick MERV-8 pleated media filters. Grille border shall be fabricated from minimum 22 gauge steel or minimum 0.040-inch thick for aluminum grilles. Provide removable grille face with metal knurled knob or quarter turn fastener to allow for filter media replacement.
- L. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- M. Manufacturers:
  - 1. Tuttle & Bailey
  - 2. Titus
  - 3. Price
  - 4. Nailor
  - 5. Carnes
  - 6. Metalaire
  - 7. Krueger
  - 8. Anemostat
  - 9. Raymon Donco

**2.2 AIR TERMINALS - SQUARE STEPDOWN CONE DIFFUSERS**

- A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.
- B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.
- C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- D. The capacity and size of the unit shall be as shown on the drawings.
- E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10-12 watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.
- F. Diffusers shall be drop face construction.
- G. Diffuser shall be entirely constructed of stamped panel and a minimum of three stepdown diffusion cones.
- H. Stepdown cones shall be mechanically fastened to panel with metal fasteners. Diffuser stepdown cones glued, fastened with plastic clips, or otherwise attached to face panel will not be acceptable.
- I. Each stepdown cone shall be one-piece stamped construction. The cones shall be removable for cleaning.
- J. Diffusers shall be constructed of minimum 24 gauge steel.
- K. Manufacturers:
  - 1. Tuttle & Bailey
  - 2. Titus
  - 3. Price
  - 4. Nailor
  - 5. Carnes
  - 6. Metalaire
  - 7. Krueger
  - 8. Anemostat
  - 9. Raymon Donco



### 2.3 FAN FILTER UNITS

- A. The FFUs shall be manufactured in the United States, be of aluminum construction, designed for installation in a standard 2'x4' T-bar ceiling grid geometry, and be fully UL and C-UL certified.
- B. FFUs connected only to low returns shall dynamically adjust themselves to maintain a set airflow, compensating for changes in static pressure and filter loading. FFUs connected downstream of supply VAV boxes shall be provided with constant speed programming (the VAV box shall control the supply air volume).
- C. The FFU shall be provided with an integral universal control (interface) card that supports operation in standalone mode, 0-10V DC remote input mode or Modbus (RTU) network compatible mode.
- D. Sound unit discharge sound levels shall be no greater than 47dBA 39NC at 650 CFM and 90FPM as determined by testing in accordance with ANSI S12.51 / ISO 3741, ANSI /ASHRAE 70-06, and ANSI / ASHRAE 130.
- E. Construction:
  - 1. The unit lid shall be constructed of 0.080-inch thick aluminum with 0.25" threaded inserts in each corner for suspension. Insert pull strength 225 lbs.
  - 2. The filter housing shall be constructed of 0.063-inch thick aluminum.
  - 3. The fan plenum housing shall be of welded construction.
  - 4. The filter shall be sealed to the filter housing with a gel seal-fluid seal material with knife edge construction. The fluid seal material is resistant to PAO and other harsh cleaning chemicals. UL 900 and UL 586 approved and ASME-AG-1 Section FC5000 for HEPA filters. Provide with white powder coated steel exterior.
  - 5. The interior of the FFU housing shall include an advanced air baffle system that ensures even distribution of air velocity +/- 10% across the filter surface.
  - 6. An optional 10" collar shall be made available.
  - 7. A sound dampening material shall be provided and shall consist of 0.5" internal non-shedding polyurethane foam attached to lid, UL 94 HF-1 rated.
- F. Provide integral filter loading indicator light in frame face.
- G. Provide integral aerosol injection port with dispersion tube and static pressure port for field test and certification.
- H. Prefilter:
  - 1. The unit shall be furnished with a 20" x 20" x 0.5" Merv 8, snap-in style, polyurethane foam, washable prefilter for use when the optional A/C collar is not in place.
- I. HEPA Filter:
  - 1. The final (HEPA) filter shall be factory tested and rated 99.99% at 0.3M PPS efficient in removal of particles 0.3 micron and larger; leak free in accordance with the latest IEST Recommended Practices.
  - 2. Filter media shall be 3 inch microglass fiber with acrylic latex binder scan tested in accordance to the current revision of IEST RP-CC0034 and IEST-RP-CC007. Filter shall be challenged with a high concentration of PSL spheres; no DOP shall be used.
  - 3. A Certificate of Compliance shall be made available for each FFU provided.
  - 4. Filter media shall be microglass fiber sealed to the aluminum housing 100%, dimple pleated separator with no aluminum ribbon or glue as separators. 3 inch media pack shall have a minimum of 250 square feet.
  - 5. The filter shall be sealed to the filter housing with a gel seal-fluid seal material with knife edge construction. The fluid seal material is resistant to PAO and other harsh cleaning chemicals. UL 900 and UL 586 approved and ASME-AG-1 Section FC5000 for HEPA filters.
  - 6. The filter and motor assembly shall be removed from room side.
  - 7. Final filter face guard shall be expanded steel, powder coated white, with aluminum diffuser screen pattern of 51% of free air space.
- J. Fan/Motor:

1. The fan will be backward curve centrifugal type with 16 inch all aluminum blower wheel.
  2. The motor shall be removable from room side.
  3. The motor shall be electrically commutative brushless DC, shall be rated for continuous duty and furnished be with thermal overload protection rated by manufacturer for 100,000 hours.
  4. Motor shall be provided with electronic sensing for forward rotation.
  5. Fan motor and controls shall be built into the unit to provide proper fan motor operation.
- K. Integral Universal Control Interface:
1. The FFU shall be provided with an integral universal control card capable of interfacing with the BACnet FMCS.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General Installation Requirements:
1. Install items in accordance with manufacturers' instructions.
  2. Install seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines, Appendix 1, Guidelines for Seismic Restraints for Kitchen Equipment".
  3. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
  4. Install diffusers to ductwork with air tight connections.
  5. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
  6. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.
- B. Volume Damper:
1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.
- C. Maintaining Duct Cleanliness:
1. When grilles, registers, and diffusers are installed, Contractor shall prevent construction dust, dirt, and debris from entering ductwork as required by Section 23 05 00.

**END OF SECTION**

**SECTION 23 81 46**  
**PACKAGED WATER SOURCE HEAT PUMPS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Accessories.

**1.2 QUALITY ASSURANCE**

- A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: Conform to AMCA 300.
- C. Fabrication: Conform to AMCA 99, AHRI 320 and /or AHRI 340.
- D. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- E. Water Source Heat Pumps: Product of manufacturer regularly engaged in production of components who issue complete catalog data on total product.
- F. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).
- G. Conform to ASHRAE 90.1.

**1.3 REFERENCES**

- A. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- B. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- C. AMCA 99 - Standards Handbook.
- D. ANSI/AFBMA - 11 Load Ratings and Fatigue Life for Ball Bearings.
- E. ANSI/AHRI 410 - Forced-Circulation Air Cooling and Air Heating Coils.
- F. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- G. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- H. ANSI/NFPA 70 - National Electrical Code.
- I. AHRI 320 - Standard for Water Source Heat Pumps.
- J. AHRI 340 - Standard for Commercial and Industrial Heat Pumps.
- K. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.

**1.4 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Product and data shall indicate capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit manufacturer's installation instructions.
- F. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- G. Submit certification that heat pumps, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
  - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in factory fabricated protective containers with factory installed shipping skids and lifting lugs.

- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

**1.6 OPERATION AND MAINTENANCE DATA**

- A. Submit operation and maintenance data.
- B. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list.

**1.7 ENVIRONMENTAL REQUIREMENTS**

- A. Do not operate units for any purpose, temporary or permanent, until filters are in place, bearings lubricated, and fan has been test run under observation.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. ClimateMaster
- B. Bosch FHP
- C. Daikin
- D. Trane
- E. Carrier
- F. AAon
- G. Whalen

**2.2 HORIZONTAL - CEILING MOUNTED HEAT PUMP**

- A. General:
  - 1. Equipment shall be completely factory assembled and tested, piped, internally wired, and fully charged with R-410A. Filters, thermostat field interface terminal strip, discharge duct collar, and all safety controls shall be furnished and factory installed.
  - 2. Capacities shall be rated in accordance with AHRI 320. Equipment shall be UL or ETL approved.
  - 3. All water source heat pumps shall be high efficiency type.
  - 4. All units shall be factory run and tested for proper operation.
- B. Housing:
  - 1. 18-gauge steel construction with baked on enamel finish. 1/2", 1-1/2 lb. density interior insulation.
  - 2. Access panels for fan, compressor and control compartments. Insulated panel separating the fan and compressor compartments.
  - 3. 1" filter bracket with side removal and 1" throwaway filter.
  - 4. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft<sup>2</sup> of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.
  - 5. Knockouts for entrance of line voltage and control wiring, all wiring connections shall be made internal to the unit.
  - 6. Supply and return water connections shall be FPT fittings and shall protrude through the cabinet for connection to flexible hose.
  - 7. Metal bracket, Isolators, and fasteners to suspend unit from building structure.
  - 8. Unit size and capacity shall be as scheduled on the drawings.
- C. Refrigerant Circuit:
  - 1. Unit shall be AHRI rated and ETL and CSA listed. Each unit shall be fully run tested at the factory with a copy of the run test report furnished with operation and maintenance manuals.
  - 2. Each unit shall have a sealed refrigerant circuit including a hermetic compressor, capillary expansion tubes, finned tube heat exchanger, reversing valve, water to refrigerant coaxial heat exchanger and safety controls to include low suction temperature, high and low-pressure switches. Safety controls shall be resettable from the main disconnect only.

3. Compressor shall be hermetic type, spring isolated for maximum sound and vibration isolation, and have thermal overload protection.
  4. Finned tube coils with aluminum fins bonded to copper tubes. UL listed coaxial heat exchanger constructed of copper inner tube and galvanized steel outer tube.
  5. Unit shall accept time delay fuses or HACR circuit breaker for branch over-current protection.
  6. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.
  7. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).
- D. Fan, Motor, and Drive:
1. Fan and compressor shall be interlocked for simultaneous operation.
  2. Units shall be provided with direct drive, multi-speed centrifugal fan with integral mounting brackets isolated from the housing and thermal overload protection.
  3. A terminal strip mounted on the fan motor to allow for motor speed change. Fan and motor shall be removable without removing attached ductwork.
- E. Electrical:
1. Disconnect provided by Electrical Contractor.
  2. Unit electrical characteristics shall be as scheduled on the drawings. Provide transformers as required for fan and control power.

### **2.3 CONTROLS**

- A. Communication Interface Panel:
1. Heat pump manufacturer shall provide communication interface panel which will provide communication between the heat pumps and the DDC system.
  2. The DDC system will provide monitoring, setpoint adjustment, and scheduling of heat pump operation.
  3. The heat pumps shall have the following monitoring and control points available to the DDC system:
    - a. Supply air temperature.
    - b. Compressor status.
    - c. Fan status.
    - d. Reversing valve status.
    - e. Condensate overflow alarm status
    - f. Leaving water temperature.
    - g. Zone space temperature.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Comb all coils to repair bent fins.
- C. Hang heat pumps from building structure, with hangers anchored to building, not from piping, conduit or ductwork. Mount as high as possible unless otherwise indicated.
- D. Protect units with protective cover during construction.
- E. P-traps must be provided for all drain pans.

### **3.2 CLEANING**

- A. After construction is completed, including painting, clean exposed surfaces of units. Clean coils and inside of units by vacuuming.
- B. Provide new, clean filter in each unit that was run prior to construction being completed.

## **END OF SECTION**



**SECTION 26 05 00**  
**BASIC ELECTRICAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

**1.2 REFERENCES**

- A. NFPA 70 - National Electrical Code (NEC)

**1.3 SCOPE OF WORK**

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Description of Systems shall be as follows:
  - 1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
  - 2. Grounding system.
  - 3. Fire alarm system.
  - 4. Wiring system for temperature control system as shown on the drawings.
  - 5. Wiring of equipment furnished by others.
  - 6. Removal work and/or relocation and reuse of existing systems and equipment.
  - 7. Telecommunications rough-in, as shown on drawings, for installation of telecommunications equipment by others under separate contract.
  - 8. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
- E. Work Not Included:
  - 1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

**1.4 OWNER FURNISHED PRODUCTS**

- A. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- B. This Contractor shall make all electrical system connections shown on the drawings or required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

**1.5 WORK SEQUENCE**

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

## 1.6 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
  2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
  3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
  4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
  5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
  6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
  7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
  8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
  9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.
  10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.
- C. General:
1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.



2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
  3. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
    - a. Luminaires.
    - b. Gravity flow piping, including steam and condensate.
    - c. Sheet metal.
    - d. Cable trays, including access space.
    - e. Other piping.
    - f. Conduits and wireway.
- D. Mechanical Contractor's Responsibility:
1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
  2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
  3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
  4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.
- E. Temperature Control Contractor's or Subcontractor's Responsibility:
1. Wiring of all devices needed to make the Temperature Control System functional.
  2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
  3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
- F. Electrical Contractor's Responsibility:
1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
  2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
  3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
  4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
  5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

## 1.7 QUALITY ASSURANCE

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

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
  2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.
- B. Qualifications:
1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
  2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.
- C. Compliance with Codes, Laws, Ordinances:
1. Conform to all requirements of the State of Montana Codes, Laws, Ordinances and other regulations having jurisdiction.
  2. Conform to all published standards of Montana State University.
  3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
  4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
  5. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
  6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
  7. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.
- D. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
  2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
  3. Pay all charges for permits or licenses.
  4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
  5. Pay all charges arising out of required inspections by an authorized body.
  6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
  7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
  8. Pay all telephone company charges related to the service or change in service.
- E. Examination of Drawings:

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

F. Electronic Media/Files:

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

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

**1.8 SUBMITTALS**

- A. Submittals shall be required as indicated in Division 1 and Division 26 specification sections.

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
1. Transmittal: Each transmittal shall include the following:
    - a. Date
    - b. Project title and number
    - c. Contractor's name and address
    - d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
    - e. Description of items submitted and relevant specification number
    - f. Notations of deviations from the contract documents
    - g. Other pertinent data
  2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
    - a. Date
    - b. Project title and number
    - c. Architect/Engineer
    - d. Contractor and subcontractors' names and addresses
    - e. Supplier and manufacturer's names and addresses
    - f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
    - g. Description of item submitted (using project nomenclature) and relevant specification number
    - h. Notations of deviations from the contract documents
    - i. Other pertinent data
    - j. Provide space for Contractor's review stamps
  3. Composition:
    - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
    - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
    - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
  4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
  5. Contractor's Approval Stamp:
    - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
    - b. Unstamped submittals will be rejected.
    - c. The Contractor's review shall include, but not be limited to, verification of the following:
      - 1) Only approved manufacturers are used.
      - 2) Addenda items have been incorporated.
      - 3) Catalog numbers and options match those specified.
      - 4) Performance data matches that specified.
      - 5) Electrical characteristics and loads match those specified.
      - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      - 7) Dimensions and service clearances are suitable for the intended location.

- 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
  - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
  - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
  - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
  - b. The Contractor shall clearly indicate the size, finish, material, etc.
  - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
  - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect/Engineer's review and processing of each submittal, excluding mailing.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
  2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
  - a. Submittal file name: 26 XX XX.description.YYYYMMDD
  - b. Transmittal file name: 26 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

**1.9 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE**

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

**1.10 WARRANTY**

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

**1.11 INSURANCE**

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

**1.12 MATERIAL SUBSTITUTION**

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.

- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.
- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

## **PART 3 - EXECUTION**

### **3.1 JOBSITE SAFETY**

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

### **3.2 ARCHITECT ENGINEER OBSERVATION OF WORK**

- A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
  - 1. Covering exterior walls, interior partitions and chases.
  - 2. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation:
  - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
    - a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.
    - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
    - c. Luminaire whips are supported above the ceiling.
    - d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.
    - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
    - f. All wall penetrations have been sealed.

2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

### **3.3 PROJECT CLOSEOUT**

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
  1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
  2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
  3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
  4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.
- C. The following must be submitted before Architect/Engineer recommends final payment:
  1. Operation and maintenance manuals with copies of approved shop drawings.
  2. Record documents including marked-up drawings and specifications.
  3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.
  4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and submit receipt to Architect/Engineer.
  5. Inspection and testing report by the fire alarm system manufacturer.
  6. Start-up reports on all equipment requiring a factory installation or start-up.
- D. Circuit Directories:
  1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

### **3.4 OPERATION AND MAINTENANCE MANUALS**

- A. General:
  1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
  2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
  1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.



2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
  3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
  4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
    - a. O&M file name: O&M.div26.contractor.YYYYMMDD
    - b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD
  5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
  6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
  7. All text shall be searchable.
  8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.
- C. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
  2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
  3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
  4. Copies of all factory inspections and/or equipment startup reports.
  5. Copies of warranties.
  6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
  7. Dimensional drawings of equipment.
  8. Detailed parts lists with lists of suppliers.
  9. Operating procedures for each system.
  10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
  11. Repair procedures for major components.
  12. Replacement parts and service material requirements for each system and the frequency of service required.
  13. Instruction books, cards, and manuals furnished with the equipment.
  14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.
  15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

### **3.5 INSTRUCTING THE OWNER'S REPRESENTATIVE**

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.

- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- D. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- E. Operating Instructions:
  - 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
  - 2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

### **3.6 RECORD DOCUMENTS**

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

### **3.7 PAINTING**

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- C. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.

### **3.8 ADJUST AND CLEAN**

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

### **3.9 SPECIAL REQUIREMENTS**

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.

- D. Raceway and Cable Routing Restrictions: Raceways and cable are restricted from being routed in the following locations, unless serving the space or permitted by the authority having jurisdiction.
  - 1. Elevator machine rooms and hoistways.
  - 2. Exit enclosures.
  - 3. Other areas restricted by code.
  - 4. Technology, data, server rooms.
  - 5. Fire pump and sprinkler rooms.
  - 6. Normal power in emergency power equipment rooms: Limited to feeders and branch circuits serving the emergency power equipment located in the room.
  - 7. Emergency power in normal power equipment rooms: Limited to feeders and branch circuits serving the normal power equipment located in the room.

**3.10 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION**

- A. Within the Limits of Construction:
  - 1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
  - 2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.
- B. Outside the Limits of Construction:
  - 1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
  - 2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
  - 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

**3.11 SYSTEM STARTING AND ADJUSTING**

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

**3.12 FIELD QUALITY CONTROL**

- A. General:
  - 1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
  - 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
  4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
  5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
  6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.
- B. Ground-Fault Equipment Performance Testing:
1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:
    - a. Service disconnects
    - b. Solid state molded case circuit breakers and solid-state insulated case circuit breakers equipped with ground fault protection.
    - c. Fusible switches with ground fault relay protection.
    - d. Outside branch circuits and feeders.
    - e. Code required.
  2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.
- C. Arc Energy Reduction Equipment Performance Testing:
1. Test: Perform arc energy protection performance testing when system is installed. The test process shall use primary current injection or approved method per manufacturer instructions and procedures. Perform test for the following:
    - a. All arc energy reduction systems installed.
  2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.
- D. Other Equipment:
1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.
- E. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.
- F. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.
- G. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for "benchmark" amperages.

#### **READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION**

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

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.

3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, medium voltage testing report has been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor \_\_\_\_\_

By \_\_\_\_\_ Date \_\_\_\_\_

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

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

**END OF SECTION**



**SECTION 26 05 05**  
**ELECTRICAL DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical demolition

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
- B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
- C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
- G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
- C. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.

**3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.
- D. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

- E. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Owner and Architect/Engineer with a Certificate of Destruction to verify proper disposal.
- I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.
- L. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.
- M. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- N. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

### **3.4 EXISTING ENCLOSURES - NEW EQUIPMENT**

- A. Existing enclosures may be reused to house new equipment including branch panels, industrial controls, and similar systems pending documented verification of the following provided with the applicable new equipment submittals.
  - 1. New equipment or panelboard is listed for the existing enclosure or application.
  - 2. Existing enclosure and new equipment is field evaluated by the manufacturer or nationally recognized testing laboratory for the available fault current, condition, and application.
  - 3. Authority Having Jurisdiction (AHJ) approval.

### **3.5 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

### **3.6 INSTALLATION**

- A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

## **END OF SECTION**



**SECTION 26 05 05 - ELECTRICAL DEMOLITION FOR REMODELING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Electrical demolition

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Materials and equipment for patching and extending work shall be as specified in individual Sections.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
- B. Where walls, ceilings, structures, etc., are indicated as being removed on general or electrical drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
- C. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
- D. Where mechanical or technology equipment is indicated as being removed on electrical, mechanical, or technology drawings, the Contractor shall be responsible for disconnecting the equipment and removing all starters, VFD, controllers, electrical equipment, raceways, wiring, etc. associated with the device.
- E. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area. Extended conduit and conductors to match existing size and material.
- F. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
- G. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.

**3.2 PREPARATION**

- A. The Contractor shall obtain approval from the Owner before turning off power to circuits, feeders, panels, etc. Coordinate all outages with Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
- C. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.

**3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Demolish and extend existing electrical work under provisions of Division 1 of Specifications and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring and raceway to source of supply. Existing conduit in good condition may be reused in place by including an equipment ground conductor in reused conduit. Reused conduit and boxes shall have supports revised to meet current codes. Relocating conduit shall not be allowed.
- D. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

- E. Disconnect and remove outlets and devices that are to be demolished. Remove outlet or devices' associated back box, supports, and conduit and conductors back to source. Patch opening created from removal of device to match surrounding finishes.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Ballasts in light fixtures installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide Owner and Architect/Engineer with a Certificate of Destruction to verify proper disposal.
- I. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide junction boxes and access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Extended conduit and conductors to match existing size and material.
- L. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in an EPA-permitted hazardous waste disposal facility or by a permitted lamp recycler.
- M. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- N. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

### **3.4 EXISTING ENCLOSURES - NEW EQUIPMENT**

- A. Existing enclosures may be reused to house new equipment including branch panels, industrial controls, and similar systems pending documented verification of the following provided with the applicable new equipment submittals.
  - 1. New equipment or panelboard is listed for the existing enclosure or application.
  - 2. Existing enclosure and new equipment is field evaluated by the manufacturer or nationally recognized testing laboratory for the available fault current, condition, and application.
  - 3. Authority Having Jurisdiction (AHJ) approval.

### **3.5 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. ELECTRICAL ITEMS (E.G., LIGHTING FIXTURES, RECEPTACLES, SWITCHES, CONDUIT, WIRE, ETC.) REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DISPOSAL OF MATERIAL THE OWNER DOES NOT WANT.

### **3.6 INSTALLATION**

- A. Install relocated materials and equipment under the provisions of Division 1 of Specifications.

**END OF SECTION**

**SECTION 26 05 13  
WIRE AND CABLE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Building wire
- B. Cabling for remote control, signal, and power limited circuits

**1.2 RELATED WORK**

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 REFERENCES**

- A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- B. NFPA 70 - National Electrical Code (NEC)
- C. UL 44 - Thermoset-Insulated Wires and Cables
- D. UL 83 - Thermoplastic-Insulated Wires and Cables
- E. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords

**PART 2 - PRODUCTS**

**2.1 BUILDING WIRE**

- A. Feeders and Branch Circuits 8 AWG and larger: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.
- B. Feeders and Branch Circuits 8 AWG and larger in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.
- C. Feeders and Branch Circuits 10 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings. Aluminum, compact stranded conductor is not acceptable for feeder and branch circuits 6 AWG and smaller.
- D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings. Three conductor stranded copper, 600-volt XHHW-2 insulation, with copper ground and overall helical copper tape shield. Shield shall be terminated at both ends of cable with an approved termination.
- E. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- F. Aluminum conductors are not to be used for feeds to motor loads.
- G. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

**2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS**

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
  - 1. Low voltage switching and lighting control

**PART 3 - EXECUTION**

**3.1 WIRE AND CABLE INSTALLATION SCHEDULE**

- A. Above Accessible Ceilings:
  - 1. Building wire shall be installed in raceway.
- B. All Other Locations: Building wire in raceway.
- C. Above Grade: All conductors installed above grade shall be type "THHN".
- D. Low Voltage Cable (less than 100 volts): Low voltage cables in ducts, plenums, and other air handling spaces shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.

**3.2 CONTRACTOR CHANGES**

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)).

- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
- C. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.
- D. Record drawing shall include the calculations and sketches.

### **3.3 GENERAL WIRING METHODS**

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.
- D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
- E. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
- F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.
- G. Splice only in junction or outlet boxes.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Make conductor lengths for parallel circuits equal.
- J. All conductors shall be continuous in conduit from last outlet to their termination.
- K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
- L. Cables or wires shall not be laid out on the ground before pulling.
- M. Cables or wires shall not be dragged over earth or paving.
- N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

### **3.4 WIRING INSTALLATION IN RACEWAYS**

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Do not use wire pulling lubricant for isolated (ungrounded) power system wiring.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.
- H. Conductor Supports in Vertical Raceways:
  - 1. Support conductors in vertical raceways in accordance with the Electrical Code Spacing of Conductors Supports.

2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

### **3.5 WIRING CONNECTIONS AND TERMINATIONS**

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
- I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
  1. Facing the front and operating side of the equipment, the phase identification shall be:
    - a. Left to Right - A-B-C
    - b. Top to Bottom - A-B-C
- J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

### **3.6 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.
- C. Inspect wire and cable for physical damage and proper connection.
- D. Torque test conductor connections and terminations to manufacturer's recommended values.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- F. Protection of wire and cable from foreign materials:
  1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.
- G. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

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**END OF SECTION**

**SECTION 26 05 26**  
**GROUNDING AND BONDING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Equipment grounding system
- B. Bonding system

**1.2 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Electrical Code, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with UL 467 Grounding and Bonding Equipment.
- E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- F. Comply with Electrical Code; for overhead-line construction and medium-voltage underground construction, comply with IEEE/ANSI C2 National Electrical Safety Code (NESC).

**1.3 REFERENCES**

- A. NFPA 70 - National Electrical Code (NEC)

**1.4 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Product Data: For the following:
  - 1. Ground rods.

**1.5 SUMMARY**

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

**PART 2 - PRODUCTS**

**2.1 GROUNDING CONDUCTORS**

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Copper Bonding Conductors: As follows:
  - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
  - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
  - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

**2.2 CONNECTOR PRODUCTS**

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Hydraulic compression type, in kit form, and selected per manufacturer's written instructions.
- C. Bolted Connectors: Bolted-pressure-type connectors.

**2.3 GROUNDING ELECTRODES**

- A. Ground Rods Copper-clad steel.

## **PART 3 - EXECUTION**

### **3.1 CONNECTIONS**

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.
- F. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity. The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.
- G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### **3.2 INSTALLATION**

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.



- D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- E. In raceways, use insulated equipment grounding conductors.

**3.3 EQUIPMENT GROUNDING SYSTEM**

- A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

**3.4 FIELD QUALITY CONTROL**

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
  - 1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

**END OF SECTION**



**SECTION 26 05 27  
SUPPORTING DEVICES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Conduit and Equipment Supports
- B. Fastening Hardware
- C. Concrete Housekeeping Pads

**1.2 QUALITY ASSURANCE**

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

**1.3 COORDINATION**

- A. Coordinate size, shape and location of concrete pads with section on Cast-in-Place Concrete or Concrete Topping.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Allied Support Systems
- B. Cooper B-Line
- C. Erico, Inc.
- D. Hilti
- E. Power Fasteners
- F. Orbit Industries

**2.2 MATERIAL**

- A. Support Channel: Hot-dip galvanized; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.
- B. Hardware: Corrosion resistant.
- C. Anchorage and Structural Attachment Components:
  - 1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.
    - a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
  - 2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
  - 3. Welding Lugs: Comply with MSS-SP-69, Type 57.
  - 4. Beam clamps for Steel Beams and Joists: Double sided or concentric open web joist hangars. Single-sided type is not acceptable.
  - 5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
  - 6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.
  - 7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
  - 8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- D. Conduit Sleeves and Lintels:
  - 1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.

2. Lintels:
    - a. Lintels in non-bearing masonry wall openings can be sized in accordance with the note below. Lintels that occur in existing bearing walls are to be sized according to similar conditions and spans in the new construction and lintel schedule. Bottom plate size shall be a minimum of 3/8" thick. The width of the plate shall be 3/4" less than the field verified wall thickness. The plate shall be the full length of the lintel member. Lintels are not required over openings that are 12" wide or less and at least 1 course below the top of the wall.
    - b. All lintels shall have a minimum of 8" end bearing.
    - c. All lintels in exterior wall construction shall be hot-dip galvanized.
    - d. For all openings not otherwise detailed or scheduled, minimum lintels shall be for each 4 inch of masonry width:
      - 1) 0 to 2'-0" span: 5/16" plate (3/4" less than wall width)
      - 2) 2'-0" to 4'-0" span: L 3 1/2 x 3 1/2 x 1/4
      - 3) 4'-0" to 6'-0" span: L 4 x 3 1/2 x 5/16 (Ilv)
      - 4) 6'-0" to 8'-0" span: L 5 x 3 1/2 x 5/16 (Ilv)
    - e. All angles that are back to back shall be welded top and bottom 3" at 12" minimum.
  3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and grouped wall openings shall be approved by the Architect or Structural Engineer.
  4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split sleeves are not acceptable. Sleeves through concrete walls may be high density polyethylene pipe penetration sleeve with a water stop collar, suitable for use with Link-Seal mechanical seals. Century-Line Model CS.
  5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
  6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.
  7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
  8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
  9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
  10. Size sleeves large enough to allow expansion and contraction movement.
- E. Concrete Housekeeping Pads:
1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings, shall be 3-1/2" thick concrete.
  2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).
  3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-trap".
  4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

- F. Truss and Joist Support System: Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
  2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
    - a. The hanger is attached within 6" from a web/chord joint.
    - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
  3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
  4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Trapeze support installation: Cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- E. Do not use powder-actuated anchors without specific permission.
- F. Do not drill structural steel members.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.
- I. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting. Provide steel channel supports to stand surface-mounted panelboard or cabinet one inch off wall.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- L. Refer to Section 26 05 33 for special conduit supporting requirements.

#### **3.2 FINISH**

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
- B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

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**END OF SECTION**

**SECTION 26 05 33  
CONDUIT AND BOXES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Rigid metallic conduit and fittings (RMC)
- B. Intermediate metallic conduit and fittings (IMC)
- C. Electrical metallic tubing and fittings (EMT)
- D. Flexible metallic conduit and fittings (FMC)
- E. Liquidtight flexible metallic conduit and fittings (LFMC)
- F. Rigid polyvinyl chloride conduit and fittings (PVC)
- G. Wall and ceiling outlet boxes
- H. Electrical connection
- I. Pull and junction boxes
- J. Rough-ins

**1.2 RELATED WORK**

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

**1.3 REFERENCES**

- A. American National Standards Institute (ANSI):
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
  - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
  - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
  - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated
  - 5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
  - 6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
  - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
  - 2. A-A-55810 - Specification for Flexible Metal Conduit
- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
  - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
  - 2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
  - 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
  - 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Underwriters Laboratories (UL): Applicable Listings
  - 1. UL 1 - Flexible Metal Conduit
  - 2. UL 6 - Rigid Metal Conduit
  - 3. UL 360 - Liquid Tight Flexible Steel Conduit
  - 4. UL514-B - Conduit Tubing and Cable Fittings
  - 5. UL651-A - Type EB and a PVC Conduit and HDPE Conduit
  - 6. UL746A - Standard for Polymeric Materials - Short Term Property Evaluations
  - 7. UL797 - Electrical Metal Tubing
  - 8. UL1242 - Intermediate Metal Conduit
- G. Definitions:
  - 1. Fittings: Conduit connection or coupling.
  - 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

#### **1.4 SUBMITTALS**

- A. Include fittings and conduits 1.5" and larger in coordination files. Include all in--floor and underfloor conduit in coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

### **PART 2 - PRODUCTS**

#### **2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS**

- A. Manufacturers:
  1. Allied
  2. LTV
  3. Steelduct
  4. Calbond Calpipe
  5. Wheatland Tube Co
  6. O-Z Gedney
  7. or approved equal.
- B. Manufacturers of RMC Conduit Fittings:
  1. Appleton Electric
  2. O-Z/Gedney Co.
  3. Electroline
  4. Raco
  5. Bridgeport
  6. Midwest
  7. Regal
  8. Thomas & Betts
  9. Crouse-Hinds
  10. Killark
  11. Orbit Industries
  12. or approved equal.
- C. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.
- D. Fittings and Conduit Bodies:
  1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
  2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
  3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
  4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.



5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.
- E. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system.
  1. Acceptable Manufacturers:
    - a. Calbond Calpipe
    - b. Robroy
    - c. T&B Ocal
    - d. or approved equal.

## **2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS**

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.
- B. Manufacturers:
  1. Allied
  2. LTV
  3. Steelduct
  4. Wheatland Tube Co
  5. O-Z Gedney
  6. or approved equal.
- C. Fittings and Conduit Bodies:
  1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
  2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
  3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
  4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
  5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

## **2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Manufacturers of EMT Conduit:
  1. Allied
  2. Calbond Calpipe
  3. LTV
  4. Steelduct
  5. Wheatland Tube Co
  6. or approved equal.
- C. Fittings and Conduit Bodies:
  1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.
  2. Larger than 2": Compression type of steel designed for their specific application.
  3. Manufacturers of EMT Conduit Fittings:
    - a. Appleton Electric
    - b. O-Z/Gedney Co.
    - c. Electroline
    - d. Raco
    - e. Bridgeport

- f. Midwest
- g. Regal
- h. Thomas & Betts
- i. Orbit Industries
- j. or approved equal.

#### **2.4 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS**

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Manufacturers:
  - 1. American Flex
  - 2. Alfex
  - 3. Electri-Flex Co
  - 4. or approved equal.
- C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.
- D. Fittings and Conduit Bodies:
  - 1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron[ or screw-in type, die-cast zinc].
  - 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
  - 3. Manufacturers:
    - a. O-Z/Gedney Co.
    - b. Thomas & Betts
    - c. Appleton Electric
    - d. Electroline
    - e. Bridgeport
    - f. Midwest
    - g. Regal
    - h. Orbit Industries
    - i. or approved equal.

#### **2.5 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS**

- A. Manufacturers:
  - 1. Anaconda Type UA
  - 2. Electri-Flex Type LA
  - 3. Alfex
  - 4. Carlon (Lamson & Sessions)
  - 5. or approved equal.
- B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.
- C. Fittings and Conduit Bodies:
  - 1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
  - 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
  - 3. Manufacturers:
    - a. Appleton Electric
    - b. O-Z/Gedney Co.
    - c. Electroline
    - d. Bridgeport
    - e. Thomas & Betts
    - f. Midwest

- g. Regal
- h. Carlon (Lamson & Sessions)
- i. Orbit Industries
- j. or approved equal.

## **2.6 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS**

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers:
  - 1. Carlon (Lamson & Sessions) Type 40
  - 2. Cantex, J.M. Mfg.
  - 3. or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

## **2.7 OUTLET BOXES**

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: Nema FB1, Type FD, Aluminum, cast ferrous alloy, or stainless steel deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.
- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
- F. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

## **2.8 ECONN; ELECTRICAL CONNECTION**

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

## **2.9 JB; PULL AND JUNCTION BOXES**

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

## **2.10 ROUGH-IN**

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,

- B. Conduit stubbed to above the lay-in ceiling.
- C. RI-TECH; Technology Rough-in:
  - 1. Rough-in shall have one (1) 1" conduit.

### **PART 3 - EXECUTION**

#### **3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING**

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.
- B. Installation Schedule: Refer to drawings.
- C. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- D. Minimum Conduit Size (Unless Noted Otherwise):
  - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
  - 2. Telecommunication Conduit: 1 inch.
  - 3. Controls Conduit: 3/4 inch.
- E. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

#### **3.2 CONDUIT ARRANGEMENT**

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- C. Conduit shall not share the same cell as structural reinforcement in masonry walls.
- D. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4" 1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.
- E. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- F. Contractor shall cooperate with all contractors on the project. Contractor shall obtain details of other contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by Contractor. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

### 3.3 CONDUIT SUPPORT

- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
  - 1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.
- G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
- K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.
- L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
- M. Finish:
  - 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
  - 2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

### 3.4 CONDUIT INSTALLATION

- A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
  2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.
  3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
  4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.
- C. Conduit Bends:
1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
  2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
  3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
  4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
    - a. A third bend is acceptable if:
      - 1) The total run is not longer than (33) feet.
      - 2) The conduit size is increased to the next trade size.
  5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
  6. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
  7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
  8. Use conduit bodies to make sharp changes in direction (i.e. around beams).
- D. Conduit Placement:
1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.
  2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
  3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
  4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.

5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system, equal to O-Z/Gedney type EYD.
9. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.
10. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
11. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
12. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
13. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
14. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

### **3.5 CONDUIT TERMINATIONS**

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.
- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the Electrical Code, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.

- F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
- G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

### **3.6 BOX INSTALLATION SCHEDULE**

- A. Galvanized steel boxes may be used in:
  - 1. Concealed interior locations above ceilings and in hollow studded partitions.
  - 2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
  - 3. Direct contact with concrete except slab on grade.
- B. Cast boxes shall be used in:
  - 1. Exterior locations.
  - 2. Wet locations.

### **3.7 COORDINATION OF BOX LOCATIONS**

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.

### **3.8 OUTLET BOX INSTALLATION**

- A. Do not install boxes back-to-back in walls.
  - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
  - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- B. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
- C. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
- D. Provide knockout closures for unused openings.
- E. Support boxes independently of conduit.
- F. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.



- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
- I. Position outlets to locate luminaires as shown on reflected ceiling drawings.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

### **3.9 PULL AND JUNCTION BOX INSTALLATION**

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Do not install boxes back-to-back in walls.
  - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
  - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

### **3.10 EXPOSED BOX INSTALLATION**

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

**END OF SECTION**



**SECTION 26 05 35**  
**SURFACE RACEWAYS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Multi-outlet assemblies

**1.2 REFERENCES**

- A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Include product data for multi-outlet assemblies and accessories.

**PART 2 - PRODUCTS**

**2.1 MULTI-OUTLET ASSEMBLY WM-)**

- A. Multi-outlet Assembly: FS W-C-582; sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as a multi-outlet assembly. Surface mount.
- B. Receptacles: Convenience receptacle mounted in cover 24 inches on center. Receptacles shall be 15-amp, 125-volt, 3-wire, grounding type, specification grade. Alternating circuit type.
- C. Finish: Stainless steel.
- D. Fittings: Couplings, elbows, outlet and device boxes, and connectors designed for use with multi-outlet system. Provide all miscellaneous fittings for an electrically and mechanically continuous system.
- E. Manufacturers:
  - 1. Wiremold 2000 series
  - 2. Mono-Systems 1900 series
  - 3. Hubbell HBL2000 series.

**PART 3 - EXECUTION**

**3.1 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY**

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- D. Fastener: Use clips and straps suitable for the purpose.
- E. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.
- F. Provide conduits to technology raceway per drawings or provide a minimum of one (1) 1-1/4" conduit per six feet of assembly (minimum 2) to above ceiling for technology requirements if assembly has technology raceway (Contractor shall provide quantities of conduits that provide maximum capacity to assembly). Provide conduits equally spaced within entire length of assembly.

**END OF SECTION**



**SECTION 26 05 53**  
**ELECTRICAL IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Adhesive Markings and Field Labels
- B. Nameplates and Signs
- C. Product Colors

**1.2 REFERENCES**

- A. NFPA 70E - National Electrical Safety Code
- B. NFPA 70 - National Electrical Code (NEC)
- C. ANSI A13.1 - Standard for Pipe Identification
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

**1.3 QUALITY ASSURANCE**

- A. Electrical identification products shall be suitable for the environment installed. Identification labels damaged by the environment due to ultraviolet light fading, damp or wet conditions, physical damage, corrosion, or other conditions shall be replaced with labels suitable for the environment.

**1.4 SUBMITTALS**

- A. General: Submit the following in accordance with Division 1 Specification Sections and under provisions of Section 26 05 00.
  - 1. Product Data for each type of product specified.
  - 2. Schedule of nomenclature to be used for identification signs and labels for each piece of equipment including, but not limited to, the following equipment types as specified in Division 26.
  - 3. Samples of each color, lettering style and other graphic representation required for identification materials including samples of labels and signs.
  - 4. Identification required in this section shall apply to equipment furnished in Division 26 and any other applicable Divisions including Division 21/22/23.

**PART 2 - PRODUCTS**

**2.1 ADHESIVE MARKINGS AND FIELD LABELS**

- A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).
  - 1. Label Size as follows:
    - a. Raceways: Kroy or Brother labels 1-inch high by 12-inches long (minimum).
  - 2. Color: As specified for various systems.
- B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- C. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- D. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- E. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from -40°F to 185°F (-40°C to 85°C), type 2/2S or type 21/21S based on application. Provide ties in specified colors when used for color coding. Cable ties shall be listed and identified for the application, securement, and support.
- F. Aluminum, Wraparound Marker Bands: 1-inch width, 0.014 (5mm) inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Brass or Aluminum Tags: 2" (50mm) by 2" (50mm) by .05-inch metal tags with stamped legend, punched for fastener.

- H. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.
- I. Text Sizes:
  - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
    - a. Font: Normal 721 Swiss Bold
    - b. Adhesive Labels: 3/16 inch minimum text height
    - c. Vinyl / Plastic Laminate Labels: 3/4" inch minimum text height

## **2.2 NAMEPLATES AND SIGNS**

- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.
- B. Text Sizes:
  - 1. The following information shall be used for text heights, fonts, and size, unless otherwise noted.
    - a. Text Height: 3/8 inch minimum
- C. Baked-Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting 1/4" grommets in corners.
- E. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- F. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

## **2.3 PRODUCT COLORS**

- A. Adhesive Markings and Field Labels:
  - 1. All Labels: Black letters on white face
  - 2. Normal Power and General Labels: Black letters on white face
  - 3. Control Labels: Black letters on white face
- B. Nameplates and Signs:
  - 1. NORMAL POWER: Black letters on white face
  - 2. Control Labels: Black letters on white face
  - 3. EMERGENCY: White letters on red face
- C. Box Covers:
  - 1. Box cover colors shall match conduit colors listed above.
- D. Conductor Color Identification: Refer to Part 3 for additional information.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Exposed Ceilings and Finished Spaces: The project includes exposed ceilings in finished spaces. The installation of colored raceways and labeling may not be aesthetically desirable in finished spaces. The contractor shall coordinate identification requirements in exposed ceilings of finished spaces with the A/E prior to installation and ordering of materials.
- C. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.
- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- E. Circuit Identification: Tag or label conductors as follows:

1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
  2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
  3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- F. Apply Danger, Warning, Caution and instruction signs as follows:
1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
  2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.
  3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
  4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.
  5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- I. Install ARC FLASH WARNING signs on all switchboards, switchgear, distribution panels, branch panelboards, industrial control panels, and motor control centers.
1. Sample Label:  
  
WARNING  
ARC FLASH AND SHOCK HAZARD  
APPROPRIATE PPE REQUIRED  
FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY  
REFER TO NFPA 70E
- J. Circuits with more than 600V: Identify raceway and cable with "DANGER-HIGH VOLTAGE" in black letters 2 (50mm) inches high on orange background at 10'-0 foot intervals.
1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
  2. Wall surfaces directly external to conduits concealed within wall.
  3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.

### 3.2 FEEDER AND BRANCH CIRCUIT DIRECTORIES

- A. Product:
1. Adhesive labels and field markings

2. Nameplates and signs
- B. Feeder Directories Branch: Provide each feeder, branch circuit, feeder modification, and branch circuit modification with a typed circuit directory label. Refer to technical equipment specification sections for additional requirements. Include the following with each label:
  1. Load Description: Lighting, receptacles, specific equipment, spare, space, or similar description.
  2. Location: Room name, number, location.
- C. Provide a factory or custom clear plastic sleeve for each branch panel directory and secure to inside panel cover. Three ring binders with individual circuit directories for each applicable branch panel may be substituted when AHJ approved, all branch panels are within the same room and within sight of the binder, and the binder is supplied with three printed copies of each directory, an electronic editable copy of the directors is saved to USB within the binder, and the binder is permanently secured an adjacent wall with a chain or metal cable with adequate length to reference the binder within the working clearance space of each applicable panel. Provide a wall mounted drop-in office bin to store the binder.

### **3.3 LIGHTING CONTROL AND RECEPTACLE COVER PLATES**

- A. Product:
  1. Nameplates and signs
- B. Identification material to be engraved plastic-laminated labels, 1/16-inch minimum thickness with white letters on a red face. Letter and number size to 1/8-inch high.
- C. Provide identification on all switch and receptacle cover plates Identification shall indicate source and circuit number serving the device (e.g. "C1A #24"). Identification for switch cover plates shall be installed on the inside cover.

### **3.4 CONDUIT AND EXPOSED CABLE LABELING**

- A. Product:
  1. Adhesive labels and field markings
- B. Conduit Identification: Pre-printed, flexible, self-adhesive vinyl labels with legend at 20 foot (6 meter) intervals to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible, or separated by enclosures, walls, partitions, ceilings, and floors. Labels for multiple conduits shall be aligned. Refer to color requirements in Part 2 when applicable in addition to the following:
  1. 1000 Volt or less Normal/Emergency Power: Indicate feeder identification and voltage.
  2. Fire Alarm: Indicate "FIRE ALARM".
  3. Grounding: Indicate "GROUND" and equipment and designation.
- C. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

### **3.5 CONDUIT AND RACEWAY COLOR BANDING FOR EXISTING CONDITIONS AND REMODELING**

- A. Existing Conduit and Raceways: Identify existing conduits and raceways within the limits of the project boundary with color banding.
  1. Existing conduit and raceways to be color banded: 3/4 inch and larger.
  2. The Contractor shall perform a review of the existing conduit, raceway, and system type prior to submitting a bid. The Contractor's review shall include a review of areas with non-finished ceilings and areas with accessible finished ceilings.
- B. New Conduit and Raceways: Identify new conduits and raceways with color banding. The following products and materials shall be identified with color banding when required by Part 1 of this specification.
  1. Rigid metallic conduit and fittings (RMC)
  2. Intermediate metallic conduit and fittings (IMC)
  3. Wire and cable installed with or without raceways:



- a. Fire-rated cable and assemblies (including but not limited to MI, fire-rated MC)
- b. Low voltage cabling
- C. Instructions:
  - 1. Band exposed or accessible raceways, cables, and bare conductors of the. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Refer to Part 1 of this specification for specific systems and colors requiring banding.
  - 2. Install bands at changes within 36 inches of direction changes, all wall/floor penetrations, at each junction box, and at 10-foot maximum intervals in straight runs.

### **3.6 BOX LABELING**

- A. Products:
  - 1. Adhesive labels and field markings
- B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape OR Brother self-laminating vinyl label, letters/numbers color coded same as conduits. In rooms that are painted out, provide labeling on inside of cover.
- C. All junction, pull, and connection boxes shall be identified as follows:
  - 1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").
  - 2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").

### **3.7 CONDUCTOR COLOR CODING**

- A. Products:
  - 1. All wire and cables shall be color coded by the manufacturer.
- B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.
- C. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.
- D. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.
- E. Conductors shall be color coded as follows:
  - 1. 208Y/120 Volt, 4-Wire:
    - a. A-Phase - Black
    - b. B-Phase - Red
    - c. C-Phase - Blue
    - d. Neutral - White
    - e. Ground Bond - Green
  - 2. 480Y/277 Volt, 4-Wire:
    - a. A-Phase - Brown
    - b. B-Phase - Orange
    - c. C-Phase - Yellow
    - d. Neutral - Gray
    - e. Ground Bond - Green
  - 3. Grounding Conductors:
    - a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.

- b. Isolated Equipment Ground Conductors: Green with colored distinctive yellow stripe along the entire length of the conductor. Isolated ground for feeders, use colored tape with alternating bands of green and yellow to provide a minimum of three bands of green and two bands of yellow.
- 4. Cabling for Remote Control, Signal, and Power Limited Circuits:
  - a. Fire Alarm: Red.
  - b. Low Voltage Switching: Per manufacturer recommendations and code requirements.
  - c. Building Automation Systems and Control: Refer to the Temperature Control Contactor notes located on the mechanical cover sheet.
  - d. Electronic Control: Per manufacturer recommendations and code requirements.

### **3.8 EQUIPMENT CONNECTION IDENTIFICATION**

- A. Products:
  - 1. Nameplates and signs
- B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.
- C. Labeling shall include:
  - 1. Equipment type and contract documents designation of equipment being served
  - 2. Location of equipment being served if it is not located within sight.
  - 3. Voltage and rating of the equipment.
  - 4. Panel and circuit numbers(s) serving the equipment
  - 5. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
  - 6. Date of fault current study; refer to one-line diagram
  - 7. Sample Label:

UNIT HEATER UH-1 ("LOCATED IN STORAGE ROOM 200")  
480V: 3-PHASE  
FED FROM "1HA1-1"  
22,000 AMPS AVAILABLE FAULT CURRENT  
DATE OF STUDY: 1 JAN 2017

### **3.9 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION**

- A. Products:
  - 1. Nameplates and signs
- B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards, switchgear, motor control centers, generators, UPS, storage battery disconnects, transfer switches, etc. Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and identify each cubicle of multi-section gear.
  - 1. Interior Equipment: The identification material shall be engraved plastic-laminated labels.
  - 2. Labeling shall include:
    - a. Equipment type and contract documents designation of equipment.
    - b. Voltage of the equipment.
    - c. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
    - d. Sample Label:  
  
DISTRIBUTION PANEL DP-H1  
480Y/277V  
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELEC ROOM)
- 3. Provide the following on a separate label, installed below the label above:
  - a. Available fault current; refer to one-line diagram or panel schedules
  - b. Date of fault current study; refer to one-line diagram

c. Sample Label:

22,000 AMPS AVAILABLE FAULT CURRENT

DATE OF STUDY: 1 JAN 2017

- C. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

### **3.10 TRANSFORMER EQUIPMENT IDENTIFICATION**

- A. Products:
1. Nameplates and signs
- B. Provide identification on the front of all transformers. The identification nameplate shall be an engraved plastic-laminated label.
- C. Labeling shall include:
1. Equipment type and contract documents designation of equipment
  2. Name of the upstream equipment.
  3. Voltage and rating of the equipment.
  4. Location of the upstream equipment if it is not located within sight.
  5. Sample Label:

TRANSFORMER TR-15

480V: 208Y/120V 15KVA

FED FROM SWITCHBOARD "SB-1" (LOCATED IN ELEC 123)

**END OF SECTION**



**SECTION 26 09 33**  
**LIGHTING CONTROL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Line and low voltage standalone lighting controls
- B. Automatic load control relay (ALCR3)
- C. Automatic load control relay (ALCR20)

**1.2 RELATED SECTIONS**

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
  - 1. 26 51 19 LED Lighting
  - 2. Electrical Drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

**1.3 RELATED WORK**

- A. Section 26 51 00 - Lighting

**1.4 QUALITY ASSURANCE**

- A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. All components and assemblies are to be factory pre-tested prior to delivery and installation.
- C. Comply with Electrical Code as applicable to electrical wiring work.
- D. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- E. Panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Panels and accessories used for control of life safety and critical branch circuits shall be listed under UL 924 Emergency Lighting and Power Equipment.
- F. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

**1.5 REFERENCES**

- A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
- B. FS W S 896 Switch, Toggle
- C. International Energy Conservation Code (IECC)
- D. NEMA WD 1 - General Color Requirements for Wiring Devices
- E. NFPA 70 - National Electrical Code (NEC)
- F. UL Standard 916 Energy Management Equipment
- G. UL 924 - Emergency Lighting and Power Equipment
- H. UL 1472 - Solid-State Dimming Controls

**1.6 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, warranty, system software requirements.
- C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

- D. Submit a list of devices and equipment that will be installed for each sequence of operation.
- E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, dimmers, relays, low voltage switches, occupancy sensors, control stations, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.

**1.7 EXTRA STOCK**

- A. Provide extra stock under provisions of Section 26 05 00.
- B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.

**1.8 PROJECT RECORD DOCUMENTS**

- A. Submit project record documents under provisions of Section 26 05 00.
- B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

**1.9 OPERATION AND MAINTENANCE DATA**

- A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:
  - 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
  - 2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
  - 3. Replacement part numbers for all system components.
- B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.
- C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

**1.10 SYSTEM DESCRIPTION**

- A. Performance Statement: This specification section and the accompanying lighting design documents describe the minimum material quality, required features, and operational requirements of the lighting control system (LCS). These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the performance required of the system, as presented in these documents, the Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring, and programming required for a complete and operational system.
- B. Provide an integrated lighting controls system consisting of panels, power supplies, controllers, sensors, relays, switches, devices, wiring, etc. necessary to perform the Lighting Control Sequence of Operation as defined on the plans and specifications. Contractor is responsible for confirming that all components and luminaires interoperate as a single system.
  - 1. Sequence of Operation: Describes the required operation and performance for lighting control in each space. Sequences of operation are indicated on the drawings.
  - 2. Drawings: The drawings include sequences of operation, locations of control interface devices, sensors, and control zones. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted with the shop drawings.
- C. The following control types and features are acceptable. Acceptable control locations are shown on the drawings.

1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.
2. Wireless Control: Equipment that uses radio frequency to transmit lighting control signals.

#### **1.11 WARRANTY**

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.
- B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 LIGHTING CONTROLS**

- A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications. Lighting control switches, systems, and components shall be listed.
- B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.
- C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

#### **2.2 LIGHTING CONTROL STATION**

- A. SW; The lighting control station shall contain the controls required by the lighting sequence of operation in a common coverplate. The controls may consist of switches, dimmers, occupancy sensors, pushbuttons, etc.
  1. In spaces where the wall control station is shown in multiple locations, the sequence of operation shall be the same at all locations, unless noted otherwise.
  2. The controls supplier shall prepare control station shop drawings showing arrangement of controls, dimensioned elevations, wiring diagram, and recommended backboxes. The shop drawing submittal should be identified with the lighting sequence that the station provides. Submit data sheets on the switches, dimmers, sensors, buttons, etc. contained in the control station.

#### **2.3 DEVICE COLOR**

- A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated otherwise.

#### **2.4 COVERPLATES**

- A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate-securing screws shall be metal with head color matching the wall plate finish.

#### **2.5 WALL SWITCHES**

- A. Refer to Electrical Symbols List for device type.
- B. SW-1P; Single Pole Switch:
  1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
  2. Manufacturers:
    - a. Hubbell HBL1221
    - b. Leviton 1221-2
    - c. Pass & Seymour PS20AC1
    - d. Cooper AH1221

#### **2.6 WALL DIMMERS**

- A. UL listed with integral air-gap switch for on/off control.
- B. Integral EMI/RFI suppression.
- C. Non-viewable heat sink.

- D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.
- E. Dimmer to match device color.
- F. SW-D-LED; LED Electronic Driver Dimmer:
  - 1. 277-volt, decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60629 Annex E.
  - 2. Manufacturers:
    - a. Compatible with provided LED driver.

Lighting Load	Load A	Load B
Step 1:	On	Off
Step 2:	Off	On
Step 3:	On	On
Step 4:	Off	Off

**2.7 AUTOMATIC LOAD CONTROL RELAY (ALCR) (INDIVIDUAL LUMINAIRE - INTEGRAL)**

- A. This section includes information related to factory and field installed ALCR devices intended for individual luminaires.
- B. ALCR3; Automatic Load Control Relay ALCR, 120/277 volt, dry/damp listed, 32°F to 113°F (0°C to 45°C) operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, listed for factory or field installation within luminaire, UL924 listed latest edition, Electrical Code Article 700 compliant.
  - 1. Rating: 3 Amp LED driver, ballast, or incandescent.
  - 2. Lighting Control Coordination: Provide ALCR device compatible with designated lighting zone controls. Example: Switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
  - 3. Operation:
    - a. ALCR device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.
    - b. ALCR device shall monitor the normal power circuit and shunt/bypass the local lighting controls upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
    - c. ALCR device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
    - d. Performance Equivalent by Other Components: A limitation of equivalent comparable products may require some of the required functions of the ALCR device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system.
      - 1) Remote test switch / fire alarm override interface.
      - 2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.
  - 4. Manufacturers:
    - a. LVS Controls EPC-2-FM (switched)
    - b. EPC-2-D-FM Series (0-10V dimming)
    - c. EPC Series (alternative lighting control)
    - d. Iota ETS-step (switched)
    - e. ETC-DR (0-10V dimming)
    - f. ETC Series (alternative lighting control)
    - g. Lighting control manufacturer



## 2.8 AUTOMATIC LOAD CONTROL RELAY (ALCR)

- A. ALCR20; Automatic Load Control Relay ALCR, 120/277 volt, dry/damp listed, 32°F to 113°F (0°C to 45°C) operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, UL924 listed latest edition, Electrical Code Article 700 compliant.
1. Rating:
    - a. 20 amp (16 A permitted) LED driver and ballast.
    - b. 10 A (1,200 watt) incandescent.
  2. Lighting Control Coordination: Provide ALCR device compatible with designated lighting zone controls. Example: switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
  3. Operation:
    - a. ALCR device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.
    - b. ALCR device shall monitor the normal power circuit and shunt/bypass the local lighting controls upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
    - c. ALCR device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
    - d. Equivalent Facilitation and Performance: A limitation of equivalent comparable products may require some of the required functions of the ALCR device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system:
      - 1) Remote test switch / fire alarm override interface.
      - 2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.
  4. Manufacturers:
    - a. LVS Controls EPC-2 (switched)
    - b. EPC-2-D Series (0-10V dimming)
    - c. EPC-DMX (DMX) EPC Series (alternative lighting control)
    - d. Iota ETS-20 (switched)
    - e. ETC-20-DR (0-10V dimming)
    - f. ETC Series (alternative lighting control)
    - g. Myers Emergency Power Systems RLY-SW-2 (switched)
    - h. RLY-DIM-2D (0-10V dimming)
    - i. RLY Series (alternative lighting control)
    - j. Nine24 Inc ELCR-R (switched)
    - k. ELCR-Z10 (0-10V dimming)
    - l. ELCR Series (alternative lighting control)
    - m. Lighting control manufacturer

## 2.9 CONDUCTORS AND CABLES

- A. Control Wiring:
1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."
  2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG with insulation rating equal to that of the line-voltage wiring.
  3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.

4. Network cabling as required by manufacturer.
- B. Splices and Taps:
  1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. All wiring shall be installed in conduit.
- C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

#### **3.3 Automatic Load Control Relays (ALCR20) and Branch circuit emergency lighting transfer switch (bcelts)**

- A. Field install per manufacturer requirements.
- B. Remote Test Switch: Provide connection to remote test switch.
- C. Fire Alarm Override: Provide connection to addressable fire alarm relay.

#### **3.4 SUPPORT SERVICES**

- A. System Startup:
  1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.
- B. Testing:
  1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
  2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Owner. The following procedures shall be performed at a minimum:
    - a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
    - b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.
    - c. Confirm that schedules and time controls are configured to meet specified performance criteria and Owner's operating requirements.
  3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.
  4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.
    - a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
    - b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent areas.
- C. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.
  2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two (2) weeks after initial training.
- D. Documentation:
1. Manufacturer shall provide system documentation including:
    - a. System one-line showing all panels, number and type of control stations and sensors, communication line, and network or BMS/BAS interface unit.
    - b. Drawings for each panel showing hardware configuration and numbering.
    - c. Panel wiring schedules.
    - d. Typical diagrams for each component.

**END OF SECTION**



**SECTION 26 22 00  
DRY TYPE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Dry type two winding transformers (TR-#)

**1.2 REFERENCES**

- A. NEMA - ST 1 - Specialty Transformers
- B. NEMA ST 20 - Dry Type Transformers for General Applications
- C. ANSI/IEEE C57.12.01 - General Requirements for Dry Type Distribution and Power Transformers
- D. ANSI/IEEE C57.12.91 - Test Code for Dry Type Distribution and Power Transformers
- E. Department of Energy 10 CFR Part 431 - Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.
- F. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
- G. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 35, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store and protect products under provisions of Section 26 05 00.
- B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

**PART 2 - PRODUCTS**

**2.1 DRY TYPE TWO WINDING TRANSFORMERS**

- A. Acceptable Manufacturers:
  - 1. Square D 7400 EX##T / SK300##KB Series
  - 2. Eaton V48M / H48M / B48M Series
  - 3. ABB 9T Series
  - 4. Hammond SG / SMK Series
  - 5. Siemens 3F3 Series
- B. Dry Type Transformers: NEMA ST 20, factory-assembled, air-cooled dry type transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.
- C. Insulation system and average winding temperature rise for rated KVA as follows:

Ratings	Class	Rise (degree C)
Less than 15	185	As shown on the drawings
or higher	220	As shown on the drawings

- D. Case temperature shall not exceed 40°C rise above ambient at its warmest point.
- E. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
- F. Winding Taps, Transformers 15 KVA and Larger: Two (2) 2-1/2% below and two (2) 2-1/2% above rated voltage, full capacity taps on primary winding.

- G. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

	Average Sound Level, Decibels			
	Self-Cooled Ventilated			Self-Cooled Sealed
Equivalent Winding kVA Range	K-Factor 1 K-Factor 4 K-Factor 9	K-Factor 13 K-Factor 20	Forced Air w/ Fans Running	
0-9	40	40	67	45
9.01-30.00	45	45	67	50
30.01-50.00	45	48	67	50
50.01-150.00	50	53	67	55
150.01-300.00	55	58	67	57
300.01-500.00	60	63	67	59
500.01-700.00	62	65	67	61
700.00-1000.00	64	67	67	63

- H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.
- J. Coil Conductors: Continuous windings with terminations brazed or welded.
- K. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.
- L. Isolate core and coil from enclosure using vibration-absorbing mounts.
- M. Nameplate: NEMA TP 3; Include transformer connection data and overload capacity based on rated allowable temperature rise.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on four 3"x3"x1/2" thick, 50 durometer rubber vibration isolating pads suitable for isolating the transformer noise from the building structure.
- D. Ventilated transformers: Provide factory label on horizontal surface to prohibit storage on top, front, or adjacent to transformer.
- E. Install primary, secondary, and grounding electrode conductors using factory or field fabricated enclosure entries. Conductors shall not be routed through ventilated openings.

**3.2 FIELD QUALITY CONTROL**

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments. Adjustments shall be made at completion of project and at approximately 6 months following project acceptance when requested by the Owner.

**END OF SECTION**

**SECTION 26 24 16  
PANELBOARDS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Lighting and appliance branch circuit panelboards: Panel '###'

**1.2 RELATED SECTIONS AND WORK**

- A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.

**1.3 REFERENCES**

- A. NEMA AB 1 - Molded Case Circuit Breakers
- B. NEMA FU 1 - Low voltage cartridge fuses
- C. NEMA KS 1 - Enclosed Switches
- D. NEMA PB 1 - Panelboards
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
- G. UL 248 - Low-Voltage Fuses
- H. UL 67 - Panelboards

**1.4 SUBMITTALS**

- A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Refurbished branch panel enclosure documentation for new branch panelboards installed in existing enclosures.
- D. Submit manufacturer's instructions under provisions of Section 26 05 00.

**1.5 SPARE PARTS**

- A. Keys: Furnish four (4) each to the Owner.

**PART 2 - PRODUCTS**

**2.1 RATINGS**

- A. Definitions:
  - 1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.
  - 2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

**2.2 BRANCH CIRCUIT PANELBOARDS**

- A. General
  - 1. Manufacturers:
    - a. Square D NQ, NF
    - b. ABB A Series
    - c. Siemens P1
    - d. Eaton PRL1, PRL2
- B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

- G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.
- H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.
- J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.
- K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.
- B. Height: 6 feet to handle of highest device.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.
- E. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.
- F. Install fuses in fusible switch assemblies.

#### **3.2 FIELD QUALITY CONTROL**

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

**END OF SECTION**



**SECTION 26 27 26**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Device plates and box covers
- B. Receptacles (REC-#)
- C. Cord and plug sets

**1.2 QUALITY ASSURANCE**

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Electrical Code, by a testing agency to Authorities Having Jurisdiction and marked for intended use.
- C. Comply with the Electrical Code.

**1.3 REFERENCES**

- A. DSCC W-C-896F - General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. NEMA WD 1 - General Color Requirements for Wiring Devices
- D. NEMA WD 6 - Wiring Devices - Dimensional Requirements
- E. NFPA 70 - National Electrical Code (NEC)
- F. UL 498 - Standard for Attachment Plugs and Receptacles
- G. UL 943 - Standard for Ground Fault Circuit Interrupters

**1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

**1.5 COORDINATION**

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- B. Cord and Plug Sets: Match equipment requirements.

**PART 2 - PRODUCTS**

**2.1 DEVICE COLOR**

- A. All switch, receptacle, and outlet colors shall be verified with Architect, unless indicated otherwise.

**2.2 COVERPLATES**

- A. All switches, receptacles, and outlets shall be complete with the following:
  - 1. Unbreakable thermoplastic/thermoset plastic and match device color#302 stainless steel coverplates in finished spaces where walls are finished.
  - 2. #302 stainless steel coverplates in unfinished spaces for flush boxes.
  - 3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate securing screws shall be metal with head color matching the wall plate finish.

**2.3 RECEPTACLES**

- A. Refer to Electrical Symbols List for device type.
- B. REC-DUP: NEMA 5-20R Duplex Receptacle:
  - 1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.
    - a. Manufacturers:
      - 1) Hubbell 5352A
      - 2) Leviton, 5362-S
      - 3) Pass & Seymour 5362
      - 4) Cooper 5352
  - 2. Heavy Duty: 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.

- a. Manufacturers:
  - 1) Hubbell 5362
  - 2) Leviton 5362
  - 3) Pass & Seymour 5362A
  - 4) Cooper AH5362
- C. REC-DUP-GFI: NEMA 5-20R Ground Fault Duplex Receptacle:
  - 1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, listed.
    - a. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
    - b. Manufacturers:
      - 1) Hubbell GF20L
      - 2) Leviton GFNT2
      - 3) Pass & Seymour 2097
      - 4) Cooper SGF20
- D. REC-SIM-620R: NEMA 6-20R Simplex Receptacle:
  - 1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
    - a. Manufacturers:
      - 1) Hubbell HBL5461
      - 2) Leviton 5461
      - 3) Pass & Seymour 5871
      - 4) Cooper 5461
- E. REC-SIM-1520R: NEMA 15-20R Simplex Receptacle:
  - 1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
    - a. Manufacturers:
      - 1) Hubbell HBL8420
      - 2) Leviton
      - 3) Pass & Seymour
      - 4) Cooper
- F. REC-SIM-L2130R: NEMA L21-30R Locking Type Simplex Receptacle:
  - 1. 120/208Y 3 phase 30-amp 5 wire grounding type.
    - a. Manufacturers:
      - 1) Hubbell HBL2750
      - 2) Cooper CWL2130R
      - 3) Pass & Seymour L2130R
- G. REC-QUAD: NEMA 5-20R Double Duplex Receptacle:
  - 1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
    - a. Manufacturers:
      - 1) Refer to Duplex Receptacle above.
- H. REC-QUAD-GFI: NEMA 5-20R Double Duplex GFI Receptacle:
  - 1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.
    - a. Manufacturers:
      - 1) Refer to Duplex GFI Receptacle above.
- I. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.
- J. Side wired devices shall have four binding screws that are undercut for positive wire retention.
- K. Ground fault circuit interrupter (GFCI) receptacles shall be listed and comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.
- C. Ground Fault Protection: Provide ground fault protection for all branch circuit breakers serving 120/208 receptacles and electrical outlets rated 50 amps or less single-phase and 100 amps or less three-phase in the following locations, as shown on drawings, or required by adopted code:
  - 1. When located within 6 feet of sinks
  - 2. Plug-and-cord receptacles when the utilization appliance is located within 6 feet of a sink edge.
- D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.
- H. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.
- I. Test receptacles for proper polarity, ground continuity and compliance with requirements.

**END OF SECTION**



**SECTION 26 28 13  
FUSES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fuses

**1.2 REFERENCES**

- A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types
- B. UL 198E - Class R Fuses
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
- D. NEMA FU 1 - Low Voltage Cartridge Fuses
- E. NFPA 70 - National Electrical Code (NEC)

**1.3 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.

**1.4 EXTRA MATERIALS**

- A. Provide two fuse pullers.
- B. Provide three of each size and type of fuse installed.

**1.5 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40°F or more than 100°F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS - FUSES**

- A. Bussman, Division of Eaton
- B. Edison Fuse, Division of Cooper Industries
- C. Mersen
- D. Littelfuse Inc

**2.2 FUSES**

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.
- D. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install fuses where indicated on the drawings and specifications.
- B. Install fuses in accordance with manufacturer's instruction.
- C. Install fuses in packaged equipment as required by equipment manufacturer.
- D. Install fuse with label oriented such that manufacturer, type, and size are easily read.

**END OF SECTION**



**SECTION 26 28 16  
DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fusible switches
- B. Non-fusible switches
- C. Motor disconnect switch
- D. Enclosures

**1.2 RELATED SECTIONS AND WORK**

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

**1.3 REFERENCES**

- A. NEMA KS 1 - Enclosed Switches

**1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Product Data: For each type of enclosed switch, circuit breakers, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

**1.5 COORDINATION**

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

**PART 2 - PRODUCTS**

**2.1 FUSIBLE AND NON-FUSIBLE SWITCHES**

- A. Acceptable Manufacturers:
  - 1. Square D 3110 Series
  - 2. Eaton DH Series
  - 3. ABB TH Series
  - 4. Siemens HNF / HF Series
- B. FDS-#; Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.
- C. DS-#; Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.
- D. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
  - 1. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

**2.2 MOTOR DISCONNECT SWITCH**

- A. Acceptable Manufacturers:
  - 1. Square D 3110 Series
  - 2. Eaton r5 Series
  - 3. ABB ML Series
  - 4. Siemens LBR Series
- B. MD-#; Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.

- C. Enclosures: Type as indicated on the Disconnect Schedule.
- D. Ground lug connection provided in enclosure.
- E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
  - 1. Lockable
  - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.
- F. Listed UL 508 suitable for motor control.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install disconnect switches where indicated on the drawings.
- B. Install fuses in fusible disconnect switches.
- C. Field coordinate installation with other contractors and equipment to maintain code required working space requirements.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

**END OF SECTION**



**SECTION 26 51 19**  
**LED LIGHTING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Interior luminaires and accessories
- B. Light-emitting diode (LED) luminaire systems

**1.2 RELATED SECTIONS**

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
  - 1. 26 09 33 Lighting Control Systems
    - a. Automatic load control relay (ALCR) (individual luminaire - integral) (ALCR3)
  - 2. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

**1.3 REFERENCES**

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products
- B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement
- C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- D. NFPA 70E - National Electrical Safety Code
- E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System
- F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products
- G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
- H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED
- I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)
- J. UL 924 - Standard for Emergency Lighting and Power Equipment
- K. UL676 Standard for Underwater Luminaires and Submersible Junction Box

**1.4 SUBMITTALS**

- A. Submit product data under provisions of Section 26 05 00.
- B. Basic Requirements of Submittal:
  - 1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
  - 2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
  - 3. Include outline drawings, support points, weights, and accessory information for each luminaire.
  - 4. Submit manufacturer origin of LED chipset and driver.

**1.5 EXTRA STOCK**

- A. Provide extra stock under provisions of Section 26 05 00.
- B. LED Light Engines or Modules: 10 percent of quantity installed, minimum one (1) of each size and type of field replaceable light engine or module. Provide field replacement installation instructions.
- C. Lenses: Three (3) percent of quantity installed, minimum one (1) of each size and type.

- D. LED Drivers: 10 percent of quantity installed, minimum one (1) of each size and type.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site. Store and protect under provisions of Section 26 05 00.
- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

**1.7 WARRANTY**

- A. The warranty period begins at the date of Substantial Completion.
- B. LED Light Engines and Drivers:
  - 1. LED Drivers and Dimming Drivers: Five (5) years
  - 2. Light Emitting Diode (LED) Light Engines: Five (5) years
- C. Automatic Load Control Relay (ALCR): Five (5) year

**1.8 REGULATORY REQUIREMENTS**

- A. Conform to NFPA 101 for installation requirements.

**PART 2 - PRODUCTS**

**2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL**

- A. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.
- B. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified. Verify suspension length prior to submittal.
- C. Painted reflector surfaces shall have a minimum reflectance of 90%.
- D. All painted components shall be painted after fabrication.

**2.2 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS**

- A. Refer to the luminaire schedule for color temperature and minimum color rendering index CRI requirements. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.
- B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- C. Rated life shall be minimum of 50,000 hours at L70.
- D. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.
- E. Luminaire delivered lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.
- F. LED luminaires shall be designed for ease of component replacement including modular replaceable boards or Zhaga sockets. Luminaires that are factory sealed and do not have field replaceable parts shall provide a 10-year warranty.
- G. LED light engine shall have a maximum LLD of 0.85 at 50,000 hours at 25°C ambient.
- H. LED Driver:
  - 1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 10%. Driver shall have a voltage fluctuation tolerance of +/- 10%.
  - 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
  - 3. Driver shall have a minimum of 50,000 hours rated life.
  - 4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.
  - 5. Driver shall be field replaceable without removal of the luminaire.
  - 6. Class A sound rating; inaudible in a 27 dBA ambient.
  - 7. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.
  - 1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:
    - a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
    - b. Luminaires 56 lbs or greater: Provide a minimum of four (4) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires. Support luminaire independent of the ceiling system.
    - c. Luminaires larger than eight square feet (8 ft<sup>2</sup>): Support luminaire independent of the ceiling system.
- B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.
- C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
- D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.
- E. Provide seismic bracing of luminaires per IBC Chapter 16. Design pendant luminaires on a component seismic coefficient (C<sub>c</sub>) of 0.67. Design vertical supports with a factor of safety of 4.0. Contractor shall verify the Seismic Hazard Exposure Group and Performance Criteria Factor.
- F. Install lamps in lamp holders of luminaires.
- G. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.
- H. Recessed luminaires and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.
- I. Industrial Pendant Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between driver and structure. Provide safety chain between reflector and driver.
- J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

#### **3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES**

- A. The Contractor shall provide temporary construction lighting per the requirements of Division 1.
- B. The project luminaires shown on the construction documents shall not be used for temporary construction purposes without providing a plan for Owner approval that addresses energy and luminaire operating hours.

#### **3.3 AUTOMATIC LOAD CONTROL RELAYS**

- A. Factory or field installation per manufacturer requirements.
- B. Remote Test Switch: Provide connection to remote test switch.
- C. Fire Alarm Override: Provide connection to addressable fire alarm relay.

#### **3.4 EMERGENCY LIGHTING UNITS AND EXIT SIGNS**

- A. Install units plumb and level.
- B. Aim directional lamp heads as directed.

- C. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

**3.5 RELAMPING**

- A. Replace failed LED light engine modules or arrays at completion of work.

**3.6 ADJUSTING AND CLEANING**

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

**3.7 LUMINAIRE SCHEDULE**

- A. As shown on the drawings.

**END OF SECTION**