

LONGVIEW SCHOOL DISTRICT HVAC CHILLER REPLACEMENTS AND INDOOR AIR QUALITY IMPROVEMENTS

**CONFORMED DOCUMENTS
VOLUME 1 OF 1
DIVISIONS 00 THROUGH 33**

**CLIENT AGENCY:
LONGVIEW PUBLIC SCHOOL
2715 LILAC ST.
LONGVIEW, WA 98632**

PREPARED BY:

integrus
ARCHITECTURE

**117 SOUTH MAIN ST. #100
SEATTLE, WA 98104
INTEGRUS PROJECT NO. 22220.00**

BID SET

NOVEMBER 15, 2022

VOLUME 1

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END OF SECTION

DIVISION 00

PROCUREMENT AND CONTRACTING

REQUIREMENTS

ADVERTISEMENT FOR BID

Bids will be accepted for the following project:

PROJECT NO.: 2022-01

TITLE: Longview School District
Chiller Replacements and Indoor Air Quality Improvements

AGENCY: Longview School District No. 122

ESTIMATED BASE QUOTE COST: **NTE \$1,600,000 + WSST**

ABBREVIATED PROJECT DESCRIPTION: Chiller Replacement and associated work at Cascade Middle School, Columbia Heights Elementary School, and Northlake Elementary School.

SUBMITTAL TIME/DATE/LOCATION: **Prior to 2:00 P.M., Tuesday, December 6th, 2022.
Bids will be accepted @
Longview School District MOTF Office
ATTN: Barbara Howe
2080 38th Avenue
Longview, WA 98632**

BY: Longview School District No. 122
Barbara Howe

PRE-PROPOSAL WALK-THROUGHS: **1:00 PM., Tuesday, November 22nd, 2022,**

Pre-proposal walk-throughs will be held at 1:00 PM starting at the Cascade Middle School, followed by Cascade Heights Elementary, and Northlake Elementary School. **Attendance of the Pre-Proposal Walk-through is Mandatory for bidders.**

The School District will make the plans available for contractors to view online without charge at:

<https://www.longviewschools.com/departments/business-services/bids-proposals>

Please direct questions regarding this project to the office of the project representative, Sara Wilder at Integrus Architecture, 117 South Main Street, Seattle WA, telephone (206) 628-3137, email: swilder@integrusarch.com

No contractor may withdraw his bid after the hour and date set for the submittal thereof, or thereafter, before award of the Contract, unless award is delayed for a period exceeding thirty (30) days from the proposal submittal date.

The Owner reserves the right to accept or reject any or all proposals and to waive informalities.

INSTRUCTIONS TO BIDDERS

1.01 DEFINITIONS

- A. All definitions set forth in the General Conditions of the Contract for Construction or in other Contract Documents are applicable to the Bidding Documents.
- B. “**Addenda**” are written or graphic instruments issued by the Architect or the Longview School District prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections. The contents of Addenda are issued in no particular order and therefore should be carefully and completely reviewed. Addenda relating to administrative matters, such as, for example, the date or time of meetings or Bid receipt, may be issued in writing by fax, mail or other delivery.
- C. An “**Alternate Bid**” (or “**Alternate**”) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted by the Longview School District.
- D. “**Award**” means the formal decision by the Longview School District notifying a Bidder with the lowest Responsive Bid of the Longview School District’s acceptance of the Bid and intent to enter into a contract with the Bidder. A contract is only formed upon execution of the contract, and not simply by Award.
- E. The “**Award Requirements**” include the following statutory requirements as a condition precedent to Award. The lowest Responsive Bidder shall:
- (1) have a certificate of registration in compliance with RCW 18.27;
 - (2) have a current state unified business identifier number;
 - (3) if applicable, have industrial insurance coverage for the Bidder’s employees working in Washington as required in Title 51 RCW;
 - (4) have an employment security department number as required in Title 50 RCW;
 - (5) have a state excise tax registration number as required in Title 82 RCW;
 - (6) not be disqualified from bidding on any public works contract under RCW 39.06.010 (unregistered or unlicensed contractors) or RCW 39.12.065(3) (prevailing wage violations);
 - (7) if bidding on a public works project subject to the apprenticeship utilization requirements in RCW 39.04.320, not have been found out of compliance by the Washington state apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under RCW 49.04 for the one-year period immediately preceding the date of the Bid solicitation;
 - (8) have received training on the requirements related to public works and prevailing wages under chapters 39.04 and 39.12 RCW, or be exempt from such training requirements if the Bidder has completed three or more public works projects and has had a valid business license in Washington for three or more years; and

- (9) within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48, or 49.52 RCW.

Further, under revised RCW 39.04.350, if the Bidder has a history of receiving monetary penalties for not achieving the apprentice utilization requirements pursuant to RCW 39.04.320, or is habitual in utilizing the good faith effort exception process, the bidder must submit an apprenticeship utilization plan within ten business days immediately following the Longview School District's notice to proceed.

- F. The “**Base Bid**” is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base to which work may be added or from which work may be deleted for sums stated in Alternate Bids.
- G. A “**Bid**” is a complete and properly signed proposal to do the Work or designated portion thereof, submitted in accordance with the Bidding Documents, for the sums therein stipulated and supported by any data called for by the Bidding Documents.
- H. A “**Bidder**” is a person or entity who submits a Bid for a prime contract with the Longview School District for the Work described in the Contract Documents.
- I. The “**Bidding Documents**” include the Advertisement or Invitation to Bid, Instructions to Bidders, the Bid form, any other sample Bidding and contract forms, the Bid Bond, and the Contract Documents, including any Addenda issued prior to receipt of Bids.
- J. The “**Contract Documents**” for the Work consist of the Agreement Between Owner and Contractor, the General Conditions of the Contract (as well as any Supplemental, Special or other Conditions included in the Project Manual), the Drawings, the Specifications, and all Addenda issued prior to, and all modifications issued after, execution of the Contract.
- K. The “**Owner**” is the Longview School District No. 122.
- L. To be considered “**Responsible**” or meet “**Responsibility**” requirements, a Bidder must meet the following supplemental criteria applicable to this Project to the satisfaction of the Architect and the Longview School District:
- (1) The ability, capacity, and skill to perform the Contract;
 - (2) The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;
 - (3) Whether the Bidder can perform the Contract within the time specified;
 - (4) The previous and existing compliance by the Bidder with laws relating to the Contract;
 - (5) The quality of performance of previous contracts, including demonstration of successful completion of three (3) similar projects of equal or greater size, scope and value in the last five (5) years;
 - (6) The designated Project Manager shall have a minimum of three (3) years of successful experience in project management and scheduling of projects of similar scope and complexity;

- (7) The designated Superintendent shall have a minimum of five (5) years of successful supervision of projects of similar scope and complexity;
 - (8) Any other qualifications required by the Contract Documents or Bidding Documents; and
 - (9) Such other information as may be secured having a bearing on the decision to award the contract.
- M. A “**Sub-bidder**” is a person or entity who submits a bid to a Bidder for materials, equipment or labor for a portion of the Work.
- N. A “**Unit Price**” is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services as described in the Bidding Documents or in the Contract Documents. The Longview School District reserves the right to reject at any time, without impairing the balance of the proposal, any or all such predetermined unit prices.

1.02 BIDDER’S REPRESENTATIONS

By making its Bid, each Bidder represents that:

- A. BIDDING DOCUMENTS. The Bidder has read and understands the Bidding Documents, and its Bid is made in accordance with them.
- B. POSSIBLE SELF-PERFORMED WORK REQUIREMENT. The Bidder will perform *with its own forces* at least that percentage (if any) of the Work required by the Bidding Documents or the Contract Documents.
- C. PRE-BID MEETING. The Bidder has attended any pre-bid meeting(s) required by the Bidding Documents.
- D. BASIS. Its Bid is based upon the materials, systems, services, and equipment required by the Bidding Documents, without exception.
- E. EXAMINATION. The Bidder has carefully examined and understands the Bidding Documents, the Contract Documents (including, without limitation, any liquidated damages and insurance provisions), and the Project site, including any existing buildings, it has familiarized itself with the local conditions under which the Work is to be performed and has correlated its observations with the requirements of the Contract Documents and it has satisfied itself as to the nature, location, character, quality and quantity of the Work, the labor, materials, equipment, goods, supplies, work, services and other items to be furnished, and all other requirements of the Contract Documents. The Bidder has also satisfied itself as to the conditions and other matters that may be encountered at the Project site or affect performance of the Work or the cost or difficulty thereof, including but not limited to those conditions and matters affecting: transportation, access, disposal, handling and storage of materials, equipment and other items; availability and quality of labor, water, electric power and utilities; availability and condition of roads; climatic conditions and seasons; physical conditions at the Project site and the surrounding locality; topography and ground surface conditions; and equipment and facilities needed preliminary to and at all times during the performance of the Work. The failure of the Bidder fully to acquaint itself with any applicable condition or matter shall not in any way relieve the Bidder from the responsibility for performing the Work in accordance with, and for the Contract Sum and within the Contract Time provided for in, the Contract Documents.
- F. PROJECT MANUAL. The Bidder has checked its copies of the Project Manual with the Table of Contents bound therein to ensure the Project Manual is complete.

- G. SEPARATE WORK. The Bidder has examined and coordinated all Drawings, Contract Documents, and Specifications for any other contracts to be awarded separately from, but in connection with, the Work being bid upon, so that the Bidder is fully informed as to conditions affecting the Work under the contract being bid upon.
- H. LICENSE REQUIREMENTS. Bidders and their proposed Subcontractors shall be registered and shall hold such licenses as may be required by the laws of Washington, including RCW 18.27, for the performance of the Work specified in the Contract Documents.
- I. NO EXCEPTIONS. Bids must be based upon the materials, systems and equipment described and required by the Bidding Documents, and terms and conditions in the Contract Documents, without exception.

1.03 BIDDING DOCUMENTS

A. COPIES

- 1. **Deposit.** Bidders may obtain electronic copies of the Bidding Documents from the issuing office and from any other locations designated in the Advertisement or Invitation to Bid. Bidders that desire paper copies may have the electronic copies reproduced at the Bidder's expense.
- 2. **Sub-bidders.** Bidding Documents will not be issued directly to Sub-bidders or others unless specifically offered in the Advertisement or Invitation to Bid.
- 3. **Complete sets.** Bidders shall use complete sets of Bidding Documents in preparing Bids and are solely responsible for utilizing established plan holder identification processes to obtain updated bid information; neither the Longview School District nor the Architect assumes any responsibility for errors or misinterpretations resulting from the use of incomplete and/or superseded sets of Bidding Documents. Printed copies of plans take precedence over any on-line images.
- 4. **Conditions.** The Longview School District and/or the Architect make copies of the Bidding Documents available on the above terms only for the purpose of obtaining Bids on the Work and do not confer a license or grant permission for any other use.
- 5. **Legible Documents.** To the extent any drawings, specifications, or other Bidding documents are not legible, it is the Bidder's responsibility to notify the Longview School District and the Architect and to obtain legible documents from the plan center.

B. INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

- 1. **Format.** The Contract Documents may be divided into parts, divisions, and sections for convenient organization and reference. Generally, there has been no attempt to divide the Specification sections into Work performed by the various building trades, any Work by separate contractors, or any Work required for separate facilities in or phases of the Project.
- 2. **Notify Owner and Architect.** Bidders and Sub-bidders shall promptly notify the Longview School District and the Architect in writing of any ambiguity, inconsistency, or error that they may discover upon examination of the Bidding Documents or of the site and local conditions. All Bidders and Sub-bidders shall thoroughly familiarize themselves with specified products and installation procedures and submit to the Longview School District and the Architect any objections (in writing) no later than seven (7) calendar days prior to the Bid Date. The submittal

of the Bid constitutes acceptance of products and procedures specified as sufficient, adequate, and satisfactory for completion of the Contract.

3. **Written request.** Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven (7) calendar days prior to the date for receipt of Bids.
4. **Addenda.** Any interpretation, correction or change of the Bidding Documents will be made by written Addendum. Interpretations, corrections or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.
5. **Singular references.** Reference in the singular to an article, device, or piece of equipment shall include as many of such articles, devices, or pieces as are indicated in the Contract Documents or as are required to complete the installation.
6. **Utilities and runs.** The Bidder should assume that the exact locations of any underground or hidden utilities, underground fuel tanks, and any plumbing and electrical runs may be somewhat different from any location indicated in the surveys or Contract Documents.
7. **Division of Contract Documents.** The Contract Documents may be divided into parts, divisions, and sections for convenient organization and reference. Generally, there has been no attempt to divide the Specification sections into Work performed by the various building trades, any Work by separate contractors, or any Work required for separate facilities in of phases of the Project.

C. SUBSTITUTIONS

1. **Standard.** The materials, products, procedures and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality that must be met by any proposed substitution.
2. **Substitution procedure.** No substitution will be considered prior to receipt of Bids unless the Architect receives a written request for approval on the Architect's Substitution Request form for the Project, with all data requested on the form completed, at least seven (7) days prior to the date for receipt of Bids. Each such request shall be submitted with a Request for Substitution form identical to or equivalent in content to the form found in the Project Manual, and shall include the name of the material or equipment proposed to be replaced and a complete description of the proposed substitute, including drawings, cuts, performance and test data, warranty information, and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The proposer has the burden to prove the merit of the proposed substitute; by proposing the substitution, the Bidder represents that it has personally investigated the proposed material or product and determined that it is equal or better in all respects to that specified, that the same or better warranty will be provided for the substitution, that complete cost data, including all direct and indirect costs of any kind, has been presented, that the Contract Time will not be increased, and that it will coordinate the installation of the substitute if accepted and make all associated changes in the Work. The Architect's decision to approve or disapprove a proposed substitution shall be final. Written requests for approval shall constitute a guarantee by the Bidder that the articles or materials are in all respects, including warranty and installation, equal or superior to those specified, unless otherwise noted. To the extent the proposed substitution will require additional services by the Architect or its consultants after Bid award, the Bidder, if successful, will be required to pay the Architect or its consultants for these services at their customary hourly rates.

3. **Addendum.** If the Architect approves a proposed substitution prior to receipt of Bids, the approval will be set forth in a written Addendum. Bidders shall not rely upon approvals made in any other manner. Substitution request forms returned by the Architect are a courtesy only, and Bidders/Sub-bidders shall rely solely on substitution approvals listed in an Addenda.
4. **Post-Bid substitutions.** After the Contract has been executed, the Longview School District and the Architect may consider a written request for the substitution of material or products in place of those specified in the Contract Documents only under the circumstances as specified therein.

D. ADDENDA

1. **Written.** All Addenda will be written. They will be mailed, emailed, faxed delivered, and/or posted electronically with notice to those the Architect knows to have registered with the Architect as a Bidder.
2. **Copies.** Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.
3. **Verification and acknowledgment of receipt.** Prior to bidding, each Bidder shall ascertain that it has received all Addenda issued. Each Bidder shall acknowledge its receipt of all Addenda in its Bid.

1.04 BIDDING PROCEDURE

A. FORM AND STYLE OF BIDS

1. **Form.** Bids (including any required attachments) shall be submitted on forms identical to the form included with the Bidding Documents. Bids on different forms may be rejected. No oral, email, or telephonic responses or modifications will be considered to be Bids.
2. **Entries on the Bid form.** All blanks on the Bid form shall be filled in by typewriter or manually in ink.
3. **Words and figures.** Where so indicated by the makeup of the Bid form, sums shall be expressed in both words and figures; in case of discrepancy between the two and regardless of any statement to the contrary on the Bid form, *the amount written in figures shall govern and the words shall be used to determine any ambiguities in the figures*. Portions of the Bid form may require the addition of component bids to a total or the identification of component amounts within a total. In case of discrepancy between component amounts listed and their sum(s), the component amounts listed shall govern.
4. **Initial changes.** Any interlineation, alteration or erasure must be initialed by an authorized representative of the Bidder.
5. **Alternates and Unit Prices.** All requested Alternates and unit prices should be bid. The Longview School District reserves the right, but is not obligated, to reject any Bid on which all requested Alternates or unit prices are not bid. If no change in the Base Bid is required for an Alternate, enter “No Change.” If there is no entry, it will be presumed that the Bidder has made no offer to accomplish this Alternate. If it is not otherwise clear from the Bid or nature of the Alternate, it will be presumed that the amount listed for an Alternate is an add rather than a deduct.

6. **No conditions.** The Bidder shall make no conditions or stipulations on the Bid form nor qualify its Bid in any other manner.
7. **Identity of Bidder.** The Bidder shall include in the specified location on the Bid form the legal name of the Bidder and, if requested, a description of the Bidder as a sole proprietor, a partnership, a joint venture, a corporation (including the state of incorporation), or another described form of legal entity. The Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder, and provide other information requested.
8. **Bid amounts do not include sales tax.** The Bid shall include in the sum stated all taxes imposed by law, EXCEPT STATE AND LOCAL SALES TAX ON THE CONTRACT SUM.
9. **Bid breakdown.** The Bid form may contain, for the Longview School District's accounting purposes only, a breakdown of some or all of the components included in the Base Bid.

B. POTENTIAL LISTING OF SUBCONTRACTORS

1. **Procedure.** On certain projects of the Longview School District, the Bid form includes a requirement that certain Subcontractors be listed, and the list must be submitted to the Longview School District as described in the bidding documents. In these circumstances, the Bidder must name the Subcontractor with whom the Bidder, if awarded the Contract, will subcontract *directly* (i.e., not lower-tier Subcontractors) for performance of the work of:
 - (a) HVAC (heating, ventilation and air conditioning),
 - (b) plumbing as described in RCW 18.106,
 - (c) electrical work as described in RCW 19.28,
 - (d) structural steel installation,
 - (e) rebar installation, and
 - (f) any other categories of Work listed on the Subcontractor listing form(s).

TIMING: The listing of HVAC, plumbing, and electrical subcontractors shall occur within one hour of the published bid submittal time. The listing of structural steel installation and rebar installation subcontractors shall occur within forty-eight hours of the published bid submittal time. The listing of any other categories of Work listed on the Subcontractor listing form(s) shall occur as indicated on such forms or as otherwise described in the bidding documents.

SELF-PERFORMANCE: If the Bidder intends to self-perform any of these categories of Work, it must name itself for each such category of Work.

IF NO SUBCONTRACTORS: If there is no work to be performed by a HVAC, plumbing, electrical, structural steel installation, rebar installation, or other subcontractor category identified on the Bid form(s), the Bidder should insert "None" or "N/A" on the Bid form. If a category is left blank, that shall indicate that the Bidder believes that there is no Work to be performed by that trade.

MULTIPLE ENTRIES: The Bidder shall not list more than one (1) entity for a particular category of Work identified, unless a Subcontractor varies with an Alternate Bid, in which case the Bidder shall identify the Subcontractor to be used for the Alternate and the affected portion of the Work and otherwise make its Bid clear as to which subcontractor shall be utilized depending upon the selection of alternates.

MULTIPLE SUBMITTAL TIMES. In the event the Bidding Documents call for a second submittal time for receipt of alternate bids, and no additional Subcontractors are listed with such alternate bids, the Longview School District will consider that there is no change in the Subcontractors from those listed with regard to the base Bid.

2. **Failure to Submit.** In accordance with RCW 39.30.060, failure of a Bidder to submit the names of such proposed heating, ventilation and air conditioning, plumbing, electrical, structural steel installation, and rebar installation Subcontractors or to name itself to perform such Work or the naming of two or more Subcontractors to perform the same Work in the time periods described above shall render the Bidder's Bid nonresponsive and, therefore, void.
3. **Requirement to Subcontract.** The Bidder, if awarded the Contract, will subcontract with the listed Subcontractor for performance of the portion of the Work designated on the Form of Proposal, subject to the provisions of the Contract for Construction and RCW 39.30.060. The Bidder shall not substitute a listed Subcontractor in furtherance of bid shopping or bid peddling.
4. **Replacement.** If a listed Subcontractor is unable to comply with any bondability, qualification, or other requirements of the Contract or Bidding Documents (including without limitation a finding of Subcontractor non-Responsibility), the Longview School District may require the Bidder to replace the Subcontractor with a Subcontractor acceptable to the Longview School District at no change in the Contract Sum or Contract Time.
5. **Subcontractor Standards.** Subcontractors shall meet contractual and technical qualifications standards, and provide specialized certification, licensing, and/or payment and performance bonding where specified.

C. **BID SECURITY**

1. **Purpose and procedure.** Each Bid shall be accompanied by a bid security payable to the Longview School District in the form required in the Bidding Documents and equal to five percent (5%) of the Base Bid. The bid security constitutes a pledge that the Bidder will enter into the Contract with the Longview School District in the form provided, in a timely manner, and on the terms stated in its Bid and will furnish in a timely manner the payment and performance bonds, certificates of insurance, Contractor's Construction Schedule, and all other documents required in the Contract Documents. Should the Bidder fail or refuse to enter into the Contract or fail to furnish such documents, the amount of the bid security shall be forfeited to the Longview School District as liquidated damages, not as a penalty. By submitting its Bid and bid security, the Bidder agrees that any forfeiture is a reasonable prediction at the time of Bid submittal of future damages to the Longview School District.
2. **Form.** The bid security shall be in the form of a certified or bank cashier's check payable to the Longview School District or a bid bond executed by a bonding company acceptable to the Longview School District and licensed in the State of Washington on the form included with the Bidding Documents (if any) or on an acceptable and equivalent form. The Attorney-in-Fact who executes the bond on behalf of the surety shall be licensed to do business in the State of Washington and shall affix to the bond a certified and current copy of that person's Power of Attorney.
3. **Retaining Bid Security.** The Longview School District will have the right to retain the Bid Security of Bidders to whom an award is being considered until the earliest of either (a) the Contract has been executed, and payment and performance bonds have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

4. **Return of Bid Security.** Within forty-five (45) days after the Bid Date, the Longview School District will release or return Bid securities to Bidders whose Bids are not to be further considered in awarding the Contract. Bid securities of the three apparent low Bidders will be held until the Contract has been finally executed, after which all unforfeited Bid securities will be returned.

D. SUBMISSION OF BIDS

1. **Procedure.** The Bid, the Bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party specified in the Advertisement or Invitation to Bidders and shall be identified with the Project name, the Bidder's name and address and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail the sealed envelope shall be enclosed in a separate mailing envelope with the notation "*SEALED BID ENCLOSED*" on the face thereof.
2. **Deposit.** Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the Advertisement or Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids may be opened, retained unopened, or returned (open or unopened), all at the discretion of the Longview School District.
3. **Responsibility.** The Bidder assumes full responsibility for timely delivery at the location designated for receipt of Bids.
4. **Form.** Oral, fax, telephonic, email, electronic, or telegraphic Bids are invalid and will not be considered.

E. MODIFICATION OR WITHDRAWAL OF BID

1. **After receipt time.** A Bid may not be modified, withdrawn or canceled by the Bidder during a forty-five (45) day period following the time and date designated for the receipt of Bids, and each Bidder so agrees by virtue of submitting its Bid.
2. **Before receipt time.** Prior to the time and date designated for receipt of Bids, any Bid submitted may be modified or withdrawn only by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder or by fax; if by fax, written confirmation over the signature of the Bidder shall be mailed and postmarked on or before the date and time set for receipt of Bids. The notice shall be worded so as not to reveal the amount of the original Bid. Email notice will not be considered. It shall be the Bidder's sole responsibility to verify that the notice has been received by the Longview School District in time to be withdrawn before the Bid opening.
3. **Resubmittal.** Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.
4. **Bid security with resubmission.** Bid security shall be in an amount sufficient for the Bid as modified or resubmitted.

F. NOTICE

1. Notice or a request from a Bidder under these Instructions to Bidders must be in writing over the signature of the Bidder and delivered in person or by mail, email, express delivery, or fax. If the notice is by email or fax, written confirmation over the signature of the Bidder must be mailed and postmarked on or before the date and time set for the notice.

1.05 CONSIDERATION OF BIDS

- A. **OPENING OF BIDS:** Unless stated otherwise in the Advertisement or Invitation to Bid or any Addendum, the properly identified Bids received on time will be opened publicly and will be read aloud. An abstract of the Base Bids and Alternate Bids, if any, will be made available to Bidders and other interested parties.
- B. **REJECTION OF BIDS:** The Longview School District shall have the right but not the obligation to reject any or all Bids for any reason or for no reason, to reject a Bid not accompanied by required Bid security or by other material or data required by the Bidding Documents, or to reject a Bid which is in any way incomplete or irregular.
- C. **ACCEPTANCE OF BID (AWARD)**
1. **Owner.** The Longview School District intends (but is not bound) to award a Contract to the lowest Responsible and Responsive Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Longview School District has the right to waive any informality or irregularity in any Bid(s) received and to accept the Bid which, in its judgment, is in its own best interests.
 2. **Alternates.** The Longview School District shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Contract Documents or Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates (if any) accepted. The Longview School District retains the right to accept Alternate Bid items at the price bid within forty-five (45) days after the Agreement is executed.
 3. **Requirements for Award.** Before the Award, the lowest Responsive Bidder shall meet the Award Requirements.
- D. **BID PROTEST PROCEDURES**
1. **Procedure.** A Bidder protesting for any reason the Bidding Documents; a bidding procedure; the Longview School District's objection to the Bidder or a person or entity proposed by the Bidder, including but not limited to a finding of non-Responsibility; the rejection of a Bid; the award of the Contract; or any other aspect arising from or relating in any way to the bidding and award or lack thereof, shall cause a written protest to be filed with the Longview School District within two (2) business days of the event giving rise to the protest and, in any event, no later than two (2) business days after the date upon which Bids are opened. (Intermediate Saturdays, Sundays, and legal holidays are not counted.) The written protest shall include the name of the protesting Bidder, a detailed description of the specific factual and legal grounds for the protest, copies of all supporting documents, and the specific relief requested. The written protest shall be delivered to:

Patti Bowen, Executive Director of Business Services
Longview School District No. 122
2715 Lilac Street
Longview, Washington 98632
pbowen@longview.k12.wa.us

2. **Consideration.** Upon receipt of the written protest, the Longview School District will consider the protest. The Longview School District may, within three (3) business days of the Longview School District's receipt of the protest, provide any other affected Bidder(s) the opportunity to respond in writing to the protest. If the protest is not resolved by mutual agreement of the protesting Bidder and the Longview School District, the Superintendent of the Longview

School District or the Superintendent's designee will review the issues and promptly furnish a final and binding written decision to the protesting Bidder and any other affected Bidder(s) within six (6) business days of the Longview School District's receipt of the protest. (If more than one (1) protest is filed, the Longview School District's decision will be provided within six (6) business days of the Longview School District's receipt of the last protest.) If no reply is received from the Longview School District during the six (6) business-day period, the protest shall be deemed rejected.

3. **Waiver.** Failure to comply with these protest procedures will render a protest waived.
4. **Condition precedent.** Timely and proper compliance with and exhaustion of these protest procedures shall be a condition precedent to any otherwise permissible judicial consideration of a protest.

1.06 POST BID INFORMATION

A. INFORMATION FROM APPARENT LOW BIDDER

1. **Submittal.** Within forty-eight (48) hours of the Architect's request, the apparent low Bidder and any other Bidders so requested shall submit the following to the Architect and the Longview School District:
 - (a) additional information regarding the use of their own forces and the use of subcontractors and suppliers;
 - (b) a properly executed Contractor's Qualification Statement on the form provided (unless otherwise required to be submitted at the time of the Bid);
 - (c) a letter or form from the Bidder's insurance company stating that the insurance required by the Contract Documents will become effective upon execution of the Contract;
 - (d) a letter or form from the Bidder's surety stating that the bond(s) required by the Contract Documents will become effective upon execution of the Contract;
 - (e) if requested by the Longview School District, a detailed breakdown of the Bid in a form acceptable to the Longview School District;
 - (f) the names of the persons or entities (including a designation of the Work to be performed with the Contractor's own forces, and the names of those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work;
 - (g) the proprietary names and the suppliers of the principal items or systems of materials and equipment proposed for the Work;
 - (h) a State Board of Education Form D-9, if requested; and
 - (i) a signed statement in accordance with RCW 9A.72.085 verifying under penalty of perjury that the bidder is in compliance with the responsible bidder criteria of RCW 39.04.350(1)(g).

Failure to provide any of the above information in a timely manner may constitute an event of breach permitting forfeiture of the Bid security.
2. **Responsibility.** The Bidder will be required to establish to the satisfaction of the Architect and the Longview School District the reliability and Responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents as well as

qualifications set forth in the Sections of the Project Manual pertaining to such proposed Subcontractor's respective trades. The Responsibility of the Bidder may be judged in part by the Responsibility of these proposed entities. The following will be considered:

- The ability, capacity, and skill to perform the contract;
- The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;
- Whether the Bidder can perform the contract within the time specified;
- The quality of performance of previous contracts;
- The previous and existing compliance by the Bidder with laws relating to the contract; and
- Such other information as may be secured having a bearing on the decision to award the contract.

CONSIDERATION. In considering a Bidder's Responsibility, a Bidder shall be deemed to be unqualified to perform the Contract if, after review and verification of the representations included upon the Contractor's Qualification Statement submitted by the Bidder, conditions such as, but not limited to, the following appear:

- (a) The Bidder does not have sufficient prior experience (or an acceptable substitute thereof, as described below) with projects of a similar nature in technical, managerial, and financial requirements to that in the present Contract being bid. In addition to such established contractors, a newly established contractor may be considered qualified if it has shown on the Contractor's Qualification Statement that it is staffed with sufficient technical, managerial, and financial personnel with prior experience in the nature of construction for which the Bids are invited.
- (b) The Bidder does not have sufficient capability to undertake the obligations of the Contract. A determination will be made when the Longview School District's review of the probable cash flow needs of the Bidder for this Project (including payroll, cost of material and supplies, equipment rental costs, and any other direct or incidental costs of the Contract), concludes that the Bidder does not have sufficient financial resources to enable it to satisfy its financial obligations under the Contract.
- (c) The Bidder has submitted unrealistic unit prices as determined by other Bidders' unit prices for this Project.
- (d) The Bidder does not have sufficient staff, equipment, or plant available to perform the Contract. The Longview School District's determination in this matter will be based upon that represented by Bidder in the Contractor's Qualification Statement.
- (e) The Bidder has a history of unsatisfactory performance of contracts of this or similar nature, regardless of whether such contracts existed between the Longview School District and the Bidder, or other parties.
 - A determination of this nature will be made if the Longview School District, after review of the Bidder previous work experience, determines that the Bidder's unsatisfactory performance has resulted predominantly from the Bidder's failure rather than a failure to perform by another party. The Longview School District will give the Contractor an opportunity to explain such nonperformance's before any final determination is reached.
 - A determination of failure to perform will be made if the Longview School District is satisfied after review of the Bidder's prior experience, that the Bidder has failed to satisfy its obligations under past contracts and the Longview School District cannot safely assume satisfactory performance of the Contract by the Bidder.
 - In reaching its determination, the Longview School District may consider statements of other parties to the prior unperformed contracts, as well as the representations of the Bidder on its Contractor's Qualification Statement.

3. **Subcontractors.** The Responsibility of the Bidder may be judged in part by the Responsibility of its Subcontractors. Bidders must verify Responsibility criteria for each first-tier Subcontractor. A Subcontractor of any tier that hires other Subcontractors must verify Responsibility criteria for each of its next lower-tier Subcontractors. Verification shall include that each Subcontractor, at the time of subcontract execution, is Responsible and possesses an electrical contractor license, if required by RCW 19.28, or an elevator contractor license, if required by RCW 70.87, and can obtain any payment and performance bonds required by the Bidding or Contract Documents.
 4. **Request to Modify Criteria.** No later than ten (10) days prior to the Bid Date, a potential Bidder may request in writing that the Longview School District modify the Responsibility criteria listed in clause (2) above or elsewhere in the Contract Documents or the Bidding Documents. The Longview School District will evaluate the information submitted by the potential Bidder and respond before the Bid Date. If the evaluation results in a change of the criteria, the Longview School District will issue an Addendum identifying the new criteria.
 5. **Objection.** Prior to the Award of the Contract, the Architect will notify the Bidder in writing if either the Longview School District or the Architect, after due investigation, has reasonable objection to the Bidder or a person or entity proposed by the Bidder, and the Longview School District will provide the reasons for the determination. The Bidder may appeal the determination within two (2) business days of its receipt of the objection by presenting additional information to the Longview School District, and the Longview School District will consider the additional information before issuing its final determination. The Bidder may, after the Longview School District's objection or determination, and at Bidder's option, (1) withdraw the Bid, (2) submit an acceptable substitute person or entity with no change in the Contract Time and no adjustment in the Base Bid or any Alternate Bid, even if there is a cost to the Bidder occasioned by the substitution, or (3) appeal by filing a protest in accordance with paragraph 1.05.D. In the event of withdrawal, Bid security will not be forfeited.
 6. **Change.** Persons and entities proposed by the Bidder and to whom the Longview School District or the Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Longview School District and the Architect.
 7. **Right to Terminate.** The Bidder's representations concerning its qualifications will be construed as a covenant under the Contract. Should it appear that the Bidder has made a material misrepresentation on its Contractor's Qualification Statement, the Longview School District shall have the right to terminate the Contract for cause for the Contractor's breach, and the Longview School District may then pursue such remedies as exist elsewhere under this Contract, or as otherwise are provided at law or equity.
- B. **INFORMATION FROM OTHER BIDDERS:** All other Bidders designated by the Architect as under consideration for award of a Contract shall also provide a properly executed Contractor's Qualification Statement, if so requested by the Longview School District.
- C. **BIDDING MISTAKES:** The Longview School District will not be obligated to consider notice of claimed bidding mistakes received more than three (3) business days after the Bid opening. In accordance with Washington law, a low Bidder that claims error and fails to enter into the Contract is prohibited from bidding on the Project if a subsequent call for Bids is made for the Project.

1.07 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

- A. **BOND REQUIREMENTS:** Within forty-eight (48) hours after the issuance of the Longview School District's notice of intent to award the Contract, and prior to the date of execution of the Contract,

the Bidder shall furnish evidence satisfactory to the Longview School District of its ability to obtain statutory bonds pursuant to RCW 39.08 covering the faithful performance of the Contract and the payment of all obligations arising thereunder in the form prescribed in the Contract Documents and in the full amount of the Contract Sum plus sales tax. The cost of such bond shall be included in the Base Bid.

- B. **SUBCONTRACTOR BONDS.** The Longview School District reserves the right to require certain Subcontractors to furnish performance and labor and material payment bonds in form as set forth herein and as set forth under the Bidding Documents or Contract Documents. The Longview School District shall not, however, be responsible for any costs for any Subcontractor bonds unless the Longview School District, prior to the execution of the Owner-Contractor Agreement, requires the Bidder, in writing, to furnish such bonds from designated Subcontractors. Should any bonds be furnished by subcontract bidders, or be required by any Bidder to be furnished by any subcontract bidder or Subcontractor, without the written request of the Longview School District, the costs for any such bonds shall be at the expense of the Bidder and shall not be added to the Contract Sum.
- C. **TIME OF DELIVERY AND FORM OF BONDS.** The Bidder shall deliver the bonds and other documents required by the Contract Documents (including but not limited to certificates of insurance) to the Longview School District pursuant to the Contract Documents and in no event any later than three (3) days after the date of execution of the Contract and prior to commencing operations at the site. The bonds shall be written in the form approved by the Longview School District for public work, as required by RCW 39.08. The bonds shall be written by a surety firm licensed to do business in the State of Washington, with an A.M. Best rating of at least A-/VII. The Bidder shall require the Attorney-in-Fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of that person's Power of Attorney.

1.08 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

- A. **FORM TO BE USED:** The Agreement for the Work will be written on the form(s) contained in the Bidding Documents, including any General, Supplemental or Special Conditions, and the other Contract Documents included with the Project Manual. In the event no form is enclosed, an AIA Document A104-2017, "Standard Abbreviated Form of Agreement Between Owner and Contractor," as revised, modified and supplemented by the Longview School District, will be used. All references in these Instructions to Bidders to the A104 refers to the document as revised by the Longview School District.
- B. **CONFLICTS:** In case of conflict between the provisions of these Instructions and any other Bidding Document, these Instructions shall govern. In case of conflict between the provisions of the Bidding Documents and the Contract Documents, the Contract Documents shall govern.

1.09 CONTRACT DOCUMENTS

This paragraph contains descriptions of some but not all of the provisions of the Contract Documents.

- A. **RETAINAGE:** The Contract Documents specify the statutory retainage requirements of RCW 60.28 for this Project.
- B. **CONTRACT TIME:** The Contract Documents specify the Contract Time. Timely completion of this Project is essential to the Longview School District.
- C. **PREVAILING WAGES:** The Contract Documents contain requirements regarding the payment of prevailing wages pursuant to RCW 39.12.

- D. WRITTEN CLAIMS AND NOTICE: The Contract Documents contain a number of provisions that require the Contractor to provide notice of Claims and to make and support Claims, in writing, within a specified time in order to maintain the Claim. The Longview School District is under no obligation to consider Claims that fail, in any respect, to meet these requirements.
- E. CHANGES IN CONTRACT SUM: The Contract Documents contain provisions specifying requirements for and pricing of changes in the Contract Sum.
- F. DISPUTE RESOLUTION: The Contract Documents contain alternative dispute resolution procedures which, among other things, requires non-binding mediation of all disputes.
- G. CONTRACTOR REGISTRATION: Pursuant to RCW 39.06, the Bidder shall be registered or licensed as required by the laws of the State of Washington, including but not limited to, RCW 18.27.
- H. TAXES. The Contractor shall include in its Bid and pay for all applicable taxes except Washington State Sales Tax and Local Sales Tax on the Contract Sum, which shall be excluded in the preparation of its Bid. Such State and Local Sales Taxes shall be added to the Contract Sum, paid by the Longview School District to the Contractor, and then paid by the Contractor over the course of the Project. Refer to general, supplementary or other conditions regarding further information.
- I. OTHER PROVISIONS: The above paragraphs contain descriptions of some but not all of the provisions of the Contract Documents. Bidders should review in detail the Contract Documents themselves and not rely upon the above paragraphs in this article as complete or inclusive.

1.10 POSSIBLE TRENCH EXCAVATION SAFETY PROVISIONS

- A. To ensure that the Bidder agrees to comply with relevant trenching safety requirements of RCW 39.04.180 and RCW 49.17, the Base Bid must include the cost of any required trench safety provisions. The Bidder shall enter in the blank (if any) provided on the Bid form the dollar amount the Bidder has included in its Base Bid for any trench safety provisions for trenching that will exceed a depth of four feet. If trench excavation safety provisions do not pertain to the Project, the Bidder may enter "N.A." or "Not Applicable" in the blank (if any) on the Bid form.

END OF SECTION

**Longview School District
HVAC Chiller Replacements and
Indoor Air Quality Improvements at Cascade Middle School, Columbia Heights Elementary
School and Northlake Elementary School**

Bid Proposal FORM

December 6, 2022, at 3:00 p.m.

Project No. 2022-01-Longview Public Schools
for

(Sealed Base Bid and Alternate Bid Due 3:00 P.M. Tuesday December 6)

To: Longview Public Schools #301
Longview School District MOTF Office
ATTN: Barbara Howe
2080 38th Avenue
Longview, WA 98632

Submitted BY (BIDDER TO ENTER NAME AND ADDRESS):

A. BIDDER'S NAME: _____

B. ADDRESS: _____

C. CITY, STATE, ZIP: _____

OFFER:

Having carefully examined the Project Manual (specifications) and the Drawings entitled Longview IAQ and Ventilation, as well as the premises and conditions affecting the Work, the undersigned represents that it has the personnel, qualifications, expertise and means to complete the Work in a timely manner and proposes to furnish all labor, equipment, and materials to perform the Base Bid Work and awarded Bid Alternates required in strict accordance with the proposed Contract Documents for the following amount:

Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in figures shall govern.

TOTAL BASE BID: Provide chillers by any manufacturer listed in Section 23 64 00:

DOLLARS (\$ _____)

OVERHEAD AND PROFIT:

All of the above bid prices include overhead and profit.

SALES TAX:

None of the above bid prices include State, County, or City Sales Tax.

OVERHEAD AND PROFIT:

All of the above bid alternates include overhead and profit.

SALES TAX:

None of the above bid prices include State, County, or City Sales Tax.

ALTERNATE BID NO. 1 – SMARDT CHILLER: Provide chillers as manufactured by SMARDT and complying with Section 23 64 00:

DOLLARS (\$_____)

OVERHEAD AND PROFIT:

All of the above bid prices include overhead and profit.

SALES TAX:

None of the above bid prices include State, County, or City Sales Tax.

OVERHEAD AND PROFIT:

All of the above bid alternates include overhead and profit.

SALES TAX:

None of the above bid prices include State, County, or City Sales Tax.

ADDENDA:

Receipt of addenda ____ through ____ is hereby acknowledged and all costs of the Work therefore have been included in the proposal.

AS A CONDITION OF SUBMITTAL OF THIS BID, THE CONTRACTOR CERTIFIES THAT:

- A. In compliance with RCW 39.12 and WAC 296-127, the Contractor shall comply with the current Cowlitz County prevailing wages. See Washington State Prevailing Wage Rates and Benefit Code Key.
- B. It is a registered contractor with RCW 18.27.
- C. It will comply with RCW 70.92, Aged and Physically Handicapped.
- D. It will comply with RCW 26A.400.330, Crimes Against Children.
- E. It has a current state unified business identifier number.
- F. It has industrial insurance coverage for the its employees working in Washington as required in Title 51 RCW
- G. It has an employment security department number as required in Title 50 RCW.

- H. It has a state excise tax registration number as required in Title 82 RCW
- I. It is not disqualified from bidding on any public works contract under RCW 39.06.010 (unregistered or unlicensed contractors) or RCW 39.12.065(3) (prevailing wage violations).
- J. Within the three-year period immediately preceding the **Bid** Date, the Bidder has not been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provisions of chapter 49.46, 49.48 or 49.52 RCW.

The undersigned certifies under penalty of perjury under the laws of the State of Washington that the foregoing representations are true and correct.

This bid may be withdrawn at any time prior to the scheduled time for the opening of bids, or any authorized postponement thereof. The District reserves the right to reject any and all bids.

THE UNDERSIGNED CERTIFIES THAT THEY ARE AUTHORIZED TO BIND THE LEGAL ENTITY MAKING THIS PROPOSAL.

In compliance with WAC 296-127, the Contractor shall pay all fees with each Statement of Intent and/or Affidavit of Wages Paid to the Department of Labor & Industries and these fees shall be considered as part of or included in the base bid.

Date attended required pre-bid walk thru: _____

Firm Name _____

Signed by _____

Official Capacity _____

Address _____

City / State _____

Date _____ Telephone _____ Fax _____

E-mail Address _____

State of Washington Contractor's License Number _____

Federal Tax Identification Number _____

Uniform Business Identifier (UBI) Number _____

Note: If bidder is a Corporation, indicate below and write "State of Incorporation" if a Partnership, indicate below and give full names and addresses of all partners.

A. (If Corporation) – State of Incorporation: _____

B. (If Partnership)- List all Partners:

1. Name: _____

a. Address: _____

2. Name: _____

b. Address: _____

3. Name: _____

c. Address: _____

DIVISION 01
GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Description of the Work.
2. Contract description.
3. Project Contacts.
4. Work by Owner or other.
5. Owner-furnished products.
6. Contractor's use of site and premises.
7. Future work.
8. Work sequence.
9. Owner occupancy.
10. Permits.
11. Ecological Requirements.
12. Terms and Definitions.
13. Specification conventions.

1.2 DESCRIPTION OF THE WORK

A. Project locations:

1. Cascade Middle School: 2821 Parkview Dr, Longview, WA 98632.
2. Columbia Heights Elementary School: 2820 Parkview Dr, Longview, WA 98632.
3. Northlake Elementary School: 2210 Olympia Way, Longview, WA 98632.

B. Replace chiller and associated work at Cascade Middle School, Columbia Heights Elementary School and Northlake Elementary School.

1.3 CONTRACT DESCRIPTION

A. Perform Work of Contract under separate Contract with Owner according to Conditions of Contract.

1.4 PROJECT CONTACTS

- A. Owner:
- B. Architect: Integrus Architecture, 117 S Main Street, Seattle, WA 98104, 206.628.3137.
- C. Structural Engineer: Integrus Architecture, 117 S Main Street, Seattle, WA 98104, 206.628.3137.
- D. Mechanical and Electrical Engineers: Hultz-BHU Engineers, 1111 Fawcett Ave, Tacoma, WA 98402.

1.5 WORK BY OWNER OR OTHERS

- A. If Owner-awarded contracts interfere with each other due to work being performed at the same time or at the same Site, Owner will determine the sequence of work under all contracts according to "Work Sequence" and "Contractor's Use of Site and Premises" Articles in this Section.
- B. Contractor is responsible for scheduling the work, storing such equipment if requested, and coordinating related work in the Contract with installation of NIC and OFOI equipment.
- C. Contractor shall provide all preparatory work necessary for proper installation including blocking and backing, and finish work including caulking, grouting, furring, and painting adjacent surfaces as required for NIC and OFOI equipment. Confirm with Owner work to be done.
- D. Coordinate Work with utilities of Owner and public or private agencies.
- E. Owner will employ a commissioning agent for this project.
- F. The Owner will employ a special inspector to perform the special inspections required as indicated on the drawings.

1.6 OWNER-FURNISHED PRODUCTS

- A. Items noted 'OFOI' (Owner Furnished, Owner Installed) will be furnished and installed by Owner as is appropriate to the flow of the work, and 'OFCI' (Owner Furnished, Contractor Installed) will be furnished to the Contractor by the Owner for the Contractor to install. Items noted 'NIC' (Not in Contract) are not in contract and will be provided by others.
- B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
 - 2. Arrange and pay for delivery to Site.
 - 3. Upon delivery, inspect products jointly with Contractor.

4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.
6. Installation of Owner furnished equipment.
7. Installation of furnishings and furniture.
8. Stocking of supplies.

C. Contractor's Responsibilities:

1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install, and finish products.
4. Contractor is responsible for scheduling the work, storing such equipment if requested, and coordinating related work in the Contract with installation of NIC and OFOI equipment.
5. Contractor shall provide all preparatory work necessary for proper installation including blocking and backing, and finish work including caulking, grouting, furring, and painting adjacent surfaces as required for NIC and OFOI equipment. Confirm with Owner work to be done.
6. Repair or replace items damaged after receipt.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Assume full responsibility for the protection and safekeeping of tools, equipment, materials, and products under this Contract, stored on the site.
- B. Assume full responsibility for site security and safety.
- C. Limit use of Site to allow:
 1. Owner occupancy.
- D. Construction Operations: Limited to areas indicated on Drawings.
 1. On-Site work hours: Work shall be only performed during hours allowed by the locality.

2. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.
 3. Provide positive means to prevent air-borne dust from dispersing into atmosphere and surrounding environment. Cover stockpiled material with tarps, wet down, and take other measures appropriate to minimize raising dust from construction operations..
- E. Time Restrictions for Performing Work: 7:00 AM - 5:00 PM..
- F. Utility Outages and Shutdown:
1. Coordinate and schedule electrical and other utility outages with Owner.
 2. Outages: Allowed only at previously agreed upon times. .
- G. Sound Level Restrictions: Comply with all applicable state and local laws, ordinances, and regulations relative to noise control. Sound pressure level measured at boundary of Site shall not exceed 60 dBA.
- H. Construction Plan: Before start of construction, post electronic file to Project website of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.
- I. Keep work and storage areas in a neat, clean and orderly condition at all times. Should it be necessary at any time to move materials or sheds, Contractor shall move same at his expense.
- J. Contractor is responsible for damage to existing property adjacent to the project site and at completion of all work, shall restore/return existing property to its original condition as it was prior to start of project work.
- K. Tobacco products are not permitted on grounds and construction site during the Work of this Contract

1.8 WORK SEQUENCE

- A. Construct Work in order to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Architect/Engineer and Owner.

1.9 OWNER OCCUPANCY

- A. Owner will occupy Site during entire period of construction.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

- C. Schedule the Work to accommodate Owner occupancy.

1.10 ECOLOGICAL REQUIREMENTS

- A. Conform to Washington State Department of Ecology and with local codes and guidelines regarding pollution control, waste reduction and recycling.
- B. Contractor is responsible for securing applicable environmental control permits from all authorities having jurisdiction over construction practices.

1.11 TERMS AND DEFINITIONS

- A. The term 'indicated' is a cross reference to details, notes or schedules on the drawings, other paragraphs or schedules in the Project Manual, and similar means of recording requirements in the contract documents.
- B. Where terms such as 'shown,' 'noted,' 'scheduled' and 'specified' are used in lieu of 'indicated,' it is for the purpose of helping the readers accomplish the cross reference and no limitation of location is intended except as specifically noted.
- C. Where not otherwise explained, terms such as 'directed,' 'requested,' 'authorized,' 'selected,' 'approved,' 'required,' 'accepted,' and 'permitted' mean 'directed by the Architect,' 'requested by the Architect,' etc. However, no such implied meaning will be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.
- D. The meaning of the word 'approve,' where used in conjunction with Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, will be held to limitations of Architect's responsibilities and duties as specified in the Conditions of the Contract. In no case will 'approval' by Architect be interpreted as a release of Contractor from responsibilities to fulfill requirements of the Contract Documents.
- E. The word 'installer' is a person or entity engaged by the Contractor or his subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that Installers be recognized experts in the work they are engaged to perform.
- F. The word 'provide' means to furnish and install.

1.12 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of Values.
- B. Application for Payment.
- C. Defect assessment.

1.2 SCHEDULE OF VALUES

- A. Submit electronic file of schedule on AIA G703 - Continuation Sheet for G702 or other Owner approved form.
- B. Submit Schedule of Values as electronic file within 15 calendar days after date established in Notice to Proceed and no less than 30 days prior to submittal of first Application of Payment.
- C. Format: Use Table of Contents of this Project Manual. Identify each line item with number and title of major Specification Section. Also identify, Site mobilization, bonds and insurance.
- D. Provide at least one line item for each listed specification section beginning with Division 2. Coordinate applicable activities with Section 013216 - Construction Progress Schedule.
- E. Round-off line item amounts to nearest whole dollar.
- F. Include within each line item, direct proportional amount of retainage and Contractor's overhead and profit.
- G. Revise schedule to list approved Change Orders with each Application for Payment.
- H. List separate line items for General, Mechanical, Electrical closeout (which includes Operation and Maintenance manuals) and include the dollar amount equal to 2% of each portion of the contract.
- I. The schedule of values shall allocate at least 1% of the original Contract Sum to Commissioning of Operational Systems.
- J. For each unit of work where payment requests will be made on account of materials or equipment purchased/fabricated/delivered but not yet installed, show "separate line items" for "order and receive" and "installation" of that unit of work.
- K. List separate line items in schedule for each Allowance amount.
- L. List separate line items for material and labor for each specification section.

- M. Except as otherwise required, major cost items, which are not directly cost of actual work-in-place, such as distinct temporary facilities, may be either shown as line items in schedule of values or distributed as general overhead expense, at Contractor's option.

1.3 APPLICATION FOR PAYMENT

- A. Submit electronic file to Architect of each Application for Payment on AIA G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
- B. Application for Initial Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. Statement of Intent to Pay Prevailing Wages on Public Works Contract on form issued by the State of Washington, Department of Labor and Industries.
 - 2. List of subcontractors including phone numbers, business address, and contact person.
 - 3. Schedule of Values.
 - 4. Contractor's Construction Schedule (preliminary if not final).
 - 5. Products list.
 - 6. Schedule of Unit Prices, as applicable.
 - 7. Submittals Schedule (preliminary if not final).
 - 8. Initial progress report.
 - 9. Certificates of insurance and insurance policies.
 - 10. Performance and payment bonds.
 - 11. List of emergency contact information.
 - 12. Other documents as may be required in the Contract Documents.
- C. Draft Payment Application:
 - 1. Submit prior to each application of payment.
 - 2. Prepare the actual payment request after the draft amounts are reviewed and agreed to by the Architect and Owner.
- D. Application for Monthly Payment: Submit on date each month as agreed between Owner and Contractor.
 - 1. Content and Format: Use Schedule of Values for listing items in Application for Payment.
 - 2. Submit updated construction schedule with each Application for Payment.

3. Payment Period: Submit at intervals stipulated in the Agreement.
4. Submit submittals with transmittal letter as specified in Section 013300 - Submittal Procedures.
- E. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 1. Current construction photographs specified in Section 013300 - Submittal Procedures.
 2. Partial release of liens from major Subcontractors and vendors.
 3. Record Documents as specified in Section 017000 - Execution and Closeout Requirements, for review by Owner, which will be returned to Contractor.
 4. Affidavits attesting to off-Site stored products.
 5. Construction Progress Schedule, revised and current as specified in Section 013300 - Submittal Procedures.
- F. Contract Retainage Value: The Owner shall pay 95% of the amount due the Contractor on account of progress payments. The remaining 5% of each payment amount shall be held as retainage until Substantial Completion at which time the retained funds will be paid to the Contractor as referenced in General Conditions Article 9 Payments and Completion for additional information. Any remaining funds will be held until final completion and will be paid to the Contractor with the Final Payment.
- G. Application at time of Substantial Completion: Show one hundred percent (100%) completion for portion of the Work claimed as substantially complete.
 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. Submit documentation that Waste Management goals (017419) have been met.
- H. Application for Final Payment:
 1. Complete and submit accepted documents as required by the General Conditions of the Contract for Construction.

1.4 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of Architect/Engineer, it is not practical to remove and replace the Work, Architect/Engineer will direct appropriate remedy or adjust payment.

- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/ Engineer.
- D. Defective Work will be partially repaired according to instructions of Architect/Engineer and unit sum/price will be adjusted to new sum/price at discretion of Architect/ Engineer.
- E. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Architect/Engineer to assess defects.
- G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling and disposing of rejected products.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements governing Alternates.
- B. General:
 - 1. Each bidder shall state in their bid, in the spaces provided on the Bid Form:
 - a. Their proposal for performing the Base Bid work.
 - b. Alternate Bid proposals described by Schedule of Alternate Bids.
 - 2. All bid prices shall include adjustments in the work of all trades as may be necessary, and shall be inclusive of all costs affected by the alternate proposal.
 - 3. Identification of Work listed below is general in nature. The Contractor shall provide all materials and associated work necessary to complete the Work of each respective described Alternate.
 - 4. The cost or credit for each Alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
 - 5. Additional Alternates, published by Addenda prior to Bid Opening are subject to provisions of this Section as if included in this Section.

1.2 DEFINITIONS

- A. The Base Bid includes all work indicated in the Contract Documents and any issued Addenda for all building and site construction work, EXCEPT the work included in the following Alternate Bids described in this section, which may result in changes to the costs.
- B. An Additive Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Contract Documents that may be added to the Base Bid amount if accepted by the Owner.
- C. A Substitute Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Contract Documents that may be added to or deducted from the Base Bid amount if accepted by the Owner.
- D. A Deductive Alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be deducted from the Base Bid amount if accepted by the Owner.

1.3 PROCEDURES

- A. Modify or adjust affected adjacent Work as necessary to completely and fully integrate the Alternate Work into the Project.
- B. Include as part of each Alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- C. Immediately following the award of the Contract, notify each party involved, in writing, of the status of each Alternate. Indicate whether Alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of any negotiated modifications to Alternates.
- D. Execute accepted Alternates under the same conditions as other Work of this Contract.
- E. A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.
- F. Bid will be evaluated on any combination of Base Bid amount and Alternates.. The Owner reserves the right to accept or reject any or all alternate bids regardless of bid prices or order in which the alternates are listed.

1.4 REINSTATEMENT OF ALTERNATES

- A. The Owner shall reserve the right to reinstate any or all of listed alternates at any time, up to a time when construction sequence and schedule shall "cover-up" that portion of work involved in any specific alternate.
- B. Reinstatement of the alternate shall be at the same figure as that given at the time of the bid opening plus additional construction cost as determined by the Construction Cost Index, as published in the Engineering News Record Magazine, latest index, after the first of the month following reinstatement.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 SCHEDULE OF ALTERNATE BIDS

- A. Additive Alternate #1 - Provide Chillers.
 - 1. Base Bid: Do not provide chillers.
 - 2. Alternate Bid #1: Provide chillers as manufactured by SMARDT and complying with Section 2364
 - 3. Related Sections: 236400.

Longview School District HVAC Chiller Replacements
and Indoor Air Quality Improvements
Integrus Project No. 22220.00

ALTERNATES
SECTION 012300

END OF SECTION 012300

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PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.
- D. Substitution Request Form.

1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

1.3 DEFINITIONS AND OPTIONS

- A. Performance, Reference Standard, and Descriptive Specifications:
 - 1. Manufacturer is not specified and requirements are specified purely by descriptive requirements, design requirements, performance requirements, reference standards, or codes.
 - 2. Products and options meeting or exceeding specified provisions are accepted.
- B. Open Proprietary Specifications:
 - 1. Products by one or more manufacturers are specified and specification makes provision for substitution requests.
 - 2. Conform to provisions for making substitution request as specified by this Section.
- C. Closed Proprietary Specifications:
 - 1. Products by one or more manufacturers are specified and specification Section does include provision for substitution requests.
 - 2. Provide work as specified. No substitution will be accepted.
- D. Basis-of-Design Specifications:

1. Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.
 2. Provide either the specified product or a comparable product by one of the other named acceptable manufacturers. Drawings and specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with Comparable Product definition below. Substitutions will be considered only when Section 012500 Substitution Procedures is referred to.
- E. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution 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.

1.4 SUBSTITUTION REQUESTS DURING BIDDING PHASE

- A. Submit Substitution Request to reach Architect's office before 5 p.m. at least 10 working days prior to date for receiving Bids.
- B. Bidders will be notified of accepted substitutions by Addendum. No other form of acceptance is valid, including as stated verbally, written, emailed, faxed, or implied in other manner and bidders shall not rely upon any approval not incorporated into the Contract Documents in this manner.

1.5 SUBSTITUTION REQUESTS DURING CONSTRUCTION PHASE

- A. Submit Substitution Requests directly by or through Contractor to Architect.
- B. Substitution Requests following Bid Date will not be considered, except at discretion of Owner and subject to reimbursement for Architect's review. Review fee will apply whether or not substitution request is accepted.
 1. Exception: Substitution Requests may be reviewed in the event of special circumstances beyond Contractor's control. Reason for substitution request must be submitted on the attached Substitution Request Form.
- C. Reasons for consideration of substitutions include:
 1. Unavailability: Specified item has been discontinued; there are no available qualified installers; or lead-time is prohibitive relative to project schedule.
 2. Unsuitability: Subsequent information discloses specified item as unsuitable, inappropriate, unable to perform properly, or to fit designated space.

3. Regulatory Requirements: Specified item fails to conform to building code interpretations or insurance regulations.
 4. Warranty: Manufacturer or fabricator has declared that specified item is unsuitable for intended use or refuses to certify or warrant performance of specified item for condition of use.
 5. Owner Prerogative: As requested by Owner for reduction of Contract Cost or Contract Time.
- D. Contractor will be notified by Architect on the form provided by the Contractor within two weeks of receipt of request, of decision to accept or reject Substitution Request.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
 3. Reference to Article and Paragraph numbers in Specification Section.
 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
 5. Changes required in other Work.
 6. Availability of maintenance service and source of replacement parts as applicable.
 7. Certified test data to show compliance with performance characteristics specified.
 8. Samples when applicable or requested.
 9. Submit list of at least 3 projects where proposed substitution has been used within past 12 months. Include name, address, and telephone number of Owner and Architect.
 10. Other information as necessary to assist Architect/Engineer's evaluation.
- B. A request constitutes a representation that Bidder or Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for substitution as for specified product.

3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
 6. Will reimburse Owner and Architect/Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.
- C. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.
- D. Substitution Submittal Procedure:
1. Submit requests for substitutions on form attached to end of this Section (an electronic version of this form is available from the Architect upon request).
 2. Submit electronic files to Project website of Request for Substitution for consideration. Limit each request to one proposed substitution.
 3. Submit only 1 Substitution Request on each Substitution Request Form. Multiple Substitution Requests on a single form will not be accepted.
 4. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 5. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1.7 UNACCEPTABLE SUBSTITUTIONS

- A. Substitutions not accepted in writing by Architect.
- B. Substitutions that are not submitted on Substitution Request Form or facsimile following this Section.
- C. Substitution Requests that do not provide complete, adequate, or clearly defined information for a thorough and timely evaluation.
- D. Substitutions that, if accepted, will require substantial revisions to Contract Documents.
- E. Substitutions that are shown or implied by shop drawings and other submittals.
- F. Substitutions not accepted by published Addenda during Bidding Period and not accepted in writing by Architect during Construction Period.

- G. Substitutions installed into the Work and not accepted by Architect, constitute non-conforming work and may be rejected by Owner without further discussion or explanation.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Initial Requirements
2. Initiating and Proposing Changes
3. Architect's Supplemental Instructions
4. Documentation of Change in Contract Sum and Contract Time.
5. Approval or Rejection of Proposal
6. Construction Change Directive
7. Change Order
8. Allowance for Overhead and Profit
9. Correlation of Contractor Submittals

1.2 INITIAL REQUIREMENTS

- A. Within 30 days of the Notice to Proceed, the Contractor shall submit a list of all equipment anticipated to be used on the project and whether it is owned or to be rented, using a form acceptable to the Architect and Owner. If during the construction process additional equipment is brought to the Project site, the Contractor shall submit an updated list.
- B. Submit name of individual authorized to receive Change Documents, and to be responsible for informing others in Contractor's employ and to applicable subcontractors of changes to the Work.

1.3 INITIATING AND PROPOSING CHANGES

- A. Proposal Request: Issued by the Architect to the Contractor on the Owner's behalf including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within seven days.
1. Proposal Requests are for information only. Do not consider them as an instruction (direction) either to stop work in progress or to execute the proposed change.

- B. Contractor Initiated Change Request: Describe proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 012500 - Substitution Procedures.

- 1. Contractor is to do no work on the proposed change until the Change Request is formalized by a Construction Change Directive or Change Order.

1.4 ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS (ASI)

- A. The Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on a form prepared by the Architect. If the Contractor believes a cost is associated with the supplemental instructions, the Contractor is to provide written notice to the Architect within 7 days of receipt of the instructions, outlining all associated costs as outlined in Part 1.4 DOCUMENTATION OF CHANGE IN CONTRACT SUM.

1.5 DOCUMENTATION OF CHANGE IN CONTRACT SUM AND CONTRACT TIME

- A. Change Order Proposal (COP): Submit electronically information required for Architect's evaluation of proposed changes.
- B. Contract Time: No additional funds will be issued or considered payable to the Contractor for time extension claims prior to Substantial Completion; the end of documented Contract Time as specified in the General Conditions AIA A201.
- C. Support each lump sum proposal quotation, and each unit price (not previously established) with sufficient substantiating data.
 - 1. On request, provide additional data to support time and cost computations:
 - a. Labor required.
 - b. Equipment required.
 - c. Products required.
 - 1) Recommended source of purchase and unit cost.
 - 2) Quantities required.
 - d. Taxes, insurance, and bonds.
 - e. Documented credit for work deleted from Contract.
 - f. Overhead and profit.
 - g. Justification for any change in Contract Time.

2. Submit additional substantiating data to support computations, as requested by Architect.
3. Support each proposal for additional costs, and time-and-material work, with documentation, as required for lump-sum proposal. Include additional information:
 - a. Name of Architect or Owner's authorized agent who ordered work, and date of order.
 - b. Dates and times work was performed, and by whom (firm or individual).
 - c. Time record, summary of hours worked, and hourly rates paid.
 - d. Receipts and invoices for:
 - 1) Equipment used, listing dates and times of use.
 - 2) Products used and listing of quantities.
 - 3) Subcontracted work.
4. Document Requests for Substitutions.
5. Statement as to whether overtime work is, or is not, necessary.

1.6 APPROVAL OR REJECTION OF PROPOSAL

A. When change is initiated by Architect or Owner:

1. Contractor to submit a detailed proposal in writing. Quotation (cost estimate) must be guaranteed for period specified in Proposal Request beginning from signing of proposal. If no period is specified, guarantee quotation for sixty (60) days from signing.
2. Architect and/or Owner will review the proposal and respond in writing with one of the following:
 - a. Request for additional information.
 - b. Approval to be issued by CCD for subsequent inclusion in a Change Order.
 - c. Rejection of the proposal and direction to continue with contracted work.
3. Contractor may not proceed with the proposed changed work until a signed CCD or Change Order is received from the Owner.

B. When a change proposal is initiated by Contractor:

1. The Architect and/or Owner will review it and respond in writing with one of the following:

- a. Approve the Contractor's cost proposal;
 - b. Request additional information;
 - c. Reject the proposal.
2. If the Owner responds by approving the Contractor's change proposal, a CCD will be processed.
 - a. If additional information is requested by Owner, respond in writing within fifteen (15) days of Owner's request.
- C. Concurrence of the Building Official:
 1. Note that all significant modifications to the Contract Documents reviewed by the AHJ, including Change Orders "approved" by the Architect and Owner, must also be approved by the Building Official.
 2. Any significant changes, such as structural changes and life safety modifications, will be submitted for review and approval to the AHJ. Contractor may not proceed with such work until the AHJ has reviewed the change and indicated that it is acceptable.

1.7 CONSTRUCTION CHANGE DIRECTIVE (CCD)

- A. Construction Change Directive:
 1. May be issued by Architect with Owner's approval, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order.
 2. Will describe changes in work, and will designate method of determining change in Contract Sum or Contract Time.
- B. Contractor: Promptly execute change to the Work.
- C. Claims for Adjustments to Contract Time or Contract Sum:
 1. Burden of proof is upon Contractor to submit data substantiating requested increase of Contract Sum and Contract Time for inclusion into approved Change Order.
 2. Submit claims within 30 days after completion of Construction Change Directive. Claims after this time are invalid.
- D. Overhead and Profit for Change to Contract Sum: Conform to provisions of Contract Documents, including the General Conditions.
- E. Prevailing Wages: Limit direct costs for labor, wages, and fringe benefits to amounts indicated by Conditions of the Contract including the General Conditions and prevailing wage rate requirements.

1.8 CHANGE ORDER (CO)

- A. Stipulated Sum Change Order
 - 1. Based on Proposal Request and Contractor's fixed maximum price quotation or Contractor's request for change.
 - 2. Execute Change Order for changes to the Work affecting Contract Sum or Contract Time.
- B. Unit Price Change Order
 - 1. Pre-determined Unit Prices and Quantities: Execute Change Order executed on fixed unit price bases.
 - 2. Unit Costs or Quantities of Units of Work Which are not Pre-Determined: Execute Work under a Construction Change Directive.
 - 3. Changes in Contract Sum or Contract Time: Compute as specified for a Time and Materials Change Order.
- C. Time and Material Change Order
 - 1. Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract.
 - 2. Allowable Change to Contract Sum and Contract Time: As determined by Architect under provisions of Contract Documents, including the General Conditions.
 - 3. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- D. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

1.9 CORRELATION OF CONTRACTOR SUBMITTALS

- A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
- B. Promptly revise progress schedules and applicable sub-schedules to reflect change in Contract Time and to adjust times for other items of work affected by the change, and resubmit.
- C. Promptly enter changes in Project Record Documents.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 012600

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction Organization.
2. Cooperation and Coordination of Work.
3. Project Coordination and Scheduling Control.
4. Mechanical and Electrical Coordination.
5. Electronic 3-D Coordination.
6. Job Site Field Measurements And Templates.
7. Dimensions.
8. Intent of Drawings.
9. Interferences and Right of Way.
10. Notification and Correction of Defective Work.
11. Coordination Utilities.
12. Closeout Coordination.

1.2 GENERAL COORDINATION REQUIREMENTS

- A. Coordinate scheduling, submittals and work identified in the Contract to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- B. Coordinate work between all Sections of Contract Documents to avoid conflicts and omissions. Take special care to coordinate work indicated as Architectural, Mechanical, Electrical and other major Divisions of the Contract Documents.
- C. Responsibility
 1. The Contractor shall be in charge of this Contract and the site, as well as the directing and scheduling of all Work. Contractor shall be on site at all times work of this Contract is in progress. Do not delegate responsibility for coordination to any subcontractor.
 2. Anticipate interrelationship of all subcontractors and their relationship with the total Work.

3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of Work between Sections. Contractor's decisions, if consistent with Contract Document requirements, shall be final.
 4. Final responsibility for the performance, interface, and completion of the Work and the Project in accordance with the Contract Documents shall be with the Contractor.
- D. Prior to any work beginning on the site, the Contractor shall submit, and receive final approval on:
1. Construction schedule;
 2. All required plans, including, but not limited to, safety, demolition, quality control, waste management and indoor air quality.
 3. All materials to be used on the project in accordance with Section 013300 - Submittal Procedures.

1.3 SPECIAL COORDINATION

- A. There are occupied spaces outside of the limits of construction. These spaces will not be vacated for construction during this contract. Any work in these surrounding areas must be coordinated with the Owner and the occupants of the adjacent areas.
- B. Additional special requirements and conditions apply to the work of this contract. Refer to Section 015000 - Temporary Facilities and Controls, for detailed description of these additional requirements and conditions.
- C. The Owner may require access to the site to perform work related or unrelated to the project. The Contractor shall coordinate with the Owner to accommodate such work within the contract time.
- D. Refer to Section 011000 - Summary for a description of other Contractor work for the Owner that is expected to be occurring within the building or other adjacent location to the construction limits of this Project. Cooperate with the Owner Contractors during the duration of this Project to prevent impact to this or other Owner projects.
- E. The Owner's staff will typically be working within the project site during Contractor's normal working hours. Contractor shall coordinate with the Owner to accommodate such work within the contract time.
- F. [The Owner's staff will typically be working within the project site during Contractor's normal working hours. Contractor shall coordinate with the Owner to accommodate such work within the contract time, including the use of any existing elevator(s), if the Contractor elects to utilize the elevator(s) as indicated in Section 015000 - Temporary Facilities and Controls.]

1.4 COORDINATION SHOP DRAWINGS

- A. Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 1. Indicate relationship of components shown on separate Shop Drawings.
 - 2. Indicate required installation sequences.

1.5 CONSTRUCTION ORGANIZATION

- A. On-Site Lines Of Authority & Communications: Refer to Section 013115 - Communication.
- B. Intra-Project Communications:
 - 1. Submittals.
 - 2. Reports and records.
 - 3. Recommendations.
 - 4. Coordination drawings.
 - 5. Schedules.
 - 6. Resolution of conflicts.
- C. Construction Mobilization
 - 1. Cooperate with the Owner's Representative in allocation of mobilization areas of the site; for field offices and sheds, for access, traffic and parking facilities.
 - 2. Comply with Architect and Owner's Representative's procedures for intra-project communications.
 - 3. Coordinate field engineering and layout work under instructions of Owner's Representative.
- D. Coordination of Reports/Activities: Coordinate both the procedural timing and the listing (naming and sequencing) of reports/activities required by provisions of this Section and other sections, to afford consistency and logical coordination between submitted reports or lists. Maintain coordination and correlation between separate reports by updating at monthly or shorter time intervals. Distribute each report and updated report to entities involved in the work, including Architect and Owner's Representative. In particular, provide close coordination of Progress Schedule, Schedule of Values (see Section 012000 - Price and Payment Procedures), listing of subcontracts, schedule of submittals, progress reports, and payment requests.
- E. Coordination of Submittals

1. Schedule and coordinate submittals specified in the Contract Documents.
 2. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to and placing equipment in service.
 3. Coordinate request for substitutions to assure compatibility of space, operating elements, and effect on work of other Sections.
- F. Coordination & Pre-Installation Meetings: Refer to Section 013119 - Project Meetings.
- G. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into the Work.

PART 2 PRODUCTS

2.1 NOT USED.

PART 3 EXECUTION

3.1 COOPERATION & COORDINATION OF WORK

- A. The Contractor is responsible for the coordination of the work of all trades; coordinating the installation of their work and that of all subcontractors to ensure compliance with the Contract Documents and to expedite the progress of the Project. Contractor shall check specifications, addenda, and drawings covering all trades as the work progresses. Contractor shall promptly report to the Architect what they consider omissions, conflicts or points requiring clarification.
- B. Contractor shall prepare and distribute to each entity performing work at project site, a written memorandum of instructions on required coordination activities, including required notices, reports and attendance at meetings.
- C. Enclosure of the Work: The Contractor shall coordinate enclosure of work with required inspections and tests, so as to avoid the necessity of uncovering work for that purpose.
- D. It is the responsibility of the Contractor to ensure that the work of subcontractors complies with Conditions of the Contract, Division 1 - General Requirements, and the work of other Sections related to their own work. No additional payments or time extensions will be authorized for failure on the part of subcontractors to be familiar with and in compliance with the aforementioned specification divisions and sections.

- E. Inclusion of portions of the work under particular divisions of the specifications or sections of the drawings does not in every case conform to the categories of work customarily subcontracted to particular crafts or trades. In such cases, the Contractor shall be responsible to inform bidders, subcontractors, crafts and trades, that work assigned to them is contained in sections other than the usual. In every case, the General Contractor shall be responsible to provide at its cost, all work required in the Contract Documents.
1. Provide project interface and coordination as required to properly and accurately bring together the several parts, components, systems, and assemblies and as required to complete the Work and the Project.
 2. Provide interface and coordination of all trades, crafts, and subcontracts as required to provide correct and accurate connection of abutting, adjoining, overlapping, and related Work, and provide all anchors, fasteners, accessories, appurtenances, and incidental items as required to complete the Work properly, fully, and correctly in accordance with the Contract Documents.
 3. Provide additional structural components, miscellaneous metal, bracing, blocking, backing, clips, anchors, fasteners, and installation accessories as required to properly anchor, fasten, or attach materials, equipment, appliances, hardware, systems, assemblies, cabinets, and architectural features to the structure.
 4. Provide excavation and backfill, trenching and drilling for all trades as required for the installation of their Work.
 5. Provide concrete foundations, pads, supports, bases, and grouting for all trades as required for the installation of their Work.
 6. Provide caulking, sealing, and flashings as required to completely weatherproof the building and as required to insulate the building thermally and acoustically. Include caulking, sealing, flashings, and related work as required to prevent moisture intrusion, air infiltration, and light leakage.
 7. Provide equipment, appliances, fixtures, and systems requiring plumbing and mechanical services, rough-in, and connections, or other utilities and services, with such services, rough-in, and final connections.
 8. Provide equipment, appliances, fixtures, and systems requiring electrical and cabling services, rough-in, and connections, or other utilities and services, with such services, rough-in, and final connections.
 9. Materials, equipment, component parts, accessories, incidental items, connections, and services required to complete the Work which are not provided by subcontractors shall be provided by the Contractor.

3.2 PROJECT COORDINATION AND SCHEDULING CONTROL

- A. The Contractor shall schedule and coordinate the work of all subcontractors on the project including their use of the site. Responsibility for coordination and close adherence to time schedules rests solely with the Contractor who shall maintain coordination and scheduling control at all times.
- B. Each subcontractor responsible to the Contractor shall cooperate diligently with the Contractor in the execution of their work so as to cause no delay in the completion of the Project. This responsibility includes the completion of all work in a timely manner. All Contractors, Prime Contractor and Subcontractors, shall diligently comply with the following requirements:
 - 1. Cooperate in planning and layout of the work well in advance of operations.
 - 2. Inform other contractors of requirements at proper time to prevent delay or revisions.
 - 3. Be informed on the requirements of other contractors and check own work for conflicts with the work of other contractors.
 - 4. Insure delivery of materials and performance of work on coordinated schedule with other contractors.
 - 5. Contractor shall ensure subcontractors and equipment suppliers are responsible for compatibility and completeness of the installation and operation of the equipment in their respective Specification Sections including conformance with code requirements.
 - 6. Attend Pre-Installation meetings identified in Section 013119.
 - 7. Contractor shall be represented on the job site by his superintendent at all times when there is construction going on, including the work of his subcontractors, as well as his own.
- C. Changing Subcontractors: The General Contractor shall be responsible for all the additional expenses incurred by changing subcontractors during the course of this project. These additional expenses include, but are not limited to, A/E expenses for duplicate or redundant submittals, requests for information, or any clarifications or revisions that might occur due to the fact that new subcontractor(s) have assumed responsibility for a portion(s) of the Work.

3.3 MECHANICAL AND ELECTRICAL COORDINATION

- A. Refer to Divisions 20 - 23 for Mechanical Coordination and Divisions 26 - 28 for Electrical Coordination.

3.4 ELECTRONIC 3D COORDINATION

- A. Provide clash detection software to determine field conflicts by comparing 3D models of building systems.

- B. Require attendance of subcontractors working on areas where clash detection is used at coordination meetings to coordinate work on site utilizing visual representation of a 3D model.

3.5 JOB SITE FIELD MEASUREMENTS AND TEMPLATES

- A. Obtain field measurements required for accurate fabrication and installation of Work included in this Contract. Exact measurements are the Contractor's responsibility.
- B. Contractor shall be responsible for field verifying actual dimensions where "+/-" dimensions are indicated, or the words "field verify."
- C. Furnish or obtain templates, patterns, and setting instructions as required for installation of all Work. Verify all dimensions in the field.

3.6 INTENT OF DRAWINGS

- A. The work of the Contractor and subcontractors shall conform to the intent of the architectural and engineering drawings as reviewed by the Architect. Drawings are partly diagrammatic and do not intend to show in details all features of work. The Contractor shall carefully review the work to be performed by other trades, compare related drawings and shall thoroughly understand the building conditions affecting their work.
- B. All changes required in the work caused by failure to do so shall be at no expense to the Owner.

3.7 INTERFERENCES AND RIGHT-OF-WAY

- A. Submit conflicts which cannot be resolved by right-of-way to the Architect for direction.
- B. Submit reflected ceiling coordination plans showing work by all applicable trades for review and approval by the Architect.

3.8 NOTIFICATION & CORRECTION OF DEFECTIVE WORK

- A. Coordinate the Work of all subcontractors and make certain that, where the work of one trade is dependent upon the work of another trade, the work first installed is properly placed, installed, aligned and finished as specified or required to properly receive subsequent materials applied or attached thereto.
- B. Direct subcontractors to correct defects in substrates they install when subcontractors of subsequent materials have a reasonable and justifiable objection to such surfaces. Promptly notify the Owner's Representative and Architect of any defects or imperfections in preparatory work which will in any way affect satisfactory completion of the work.
- C. Under no condition shall a section of work proceed prior to preparatory work having been completed, cured, dried or otherwise made satisfactory to receive such related work. Do not force subcontractors to apply or install products to improperly finished product.

- D. Correction of defective work shall be the responsibility of the Contractor or subcontractor providing the defective work. Correction of work due to underlying defects shall be the responsibility of the Contractor or subcontractor providing overlying work.

3.9 COORDINATING UTILITIES

- A. Contractor shall be responsible for coordination of and shall cooperate with all utilities to be installed for service to the Project. Utilities may include, but are not limited to, natural gas, telephone, electrical, and cable television. The Contractor shall maintain communication with the utilities in order to coordinate time and requirements of the utilities' installation.
- B. Contractor shall provide all work necessary to comply with the requirements of the Contract Documents for utility work that does not meet the Contract Document requirements, or for work that is disturbed by the utility installation.

3.10 CLOSEOUT COORDINATION

- A. General
 - 1. Coordinate completion and cleanup of work by the various trades in preparation for Substantial Completion.
 - 2. After Owner occupancy of premises, coordinate access to site by the various trades involved for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
 - 3. Assemble and coordinate closeout submittals.
- B. At completion of Work of each Subcontract, conduct inspection to assure that:
 - 1. Work is acceptable.
 - 2. Temporary facilities and debris have been removed from site.
- C. At Substantial Completion:
 - 1. Conduct inspection and prepare list of work to be completed or corrected.
 - 2. Assist Architect and Owner's Representative in inspection.
 - 3. Supervise correction and completion of Work as established in Architect's inspection reports ("punch lists").
 - 4. Obtain Certificate of Occupancy from governing authorities.
- D. At Final Completion: Assist Architect and Owner's Representative in inspection.

END OF SECTION 013100

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General Communication.
 - 2. Emergency Communication.
 - 3. Correspondence.
 - 4. Request for Information.
 - 5. Non Compliance Notice.

1.2 GENERAL COMMUNICATION

- A. All telephone and electronic communication and other correspondence shall be between Contractor and Architect, unless otherwise noted below.
- B. Subcontractors are not to contact members of the design team directly unless explicitly agreed to by Contractor, Architect and Owner's Representative. All such contact and discussions are to be documented in writing by the subcontractor and submitted to the Architect and Owner's Representative through the Contractor.
- C. The General Contractor shall transmit problems or questions in writing using a Request for Information (RFI) form.
- D. On-Site Lines of Authority and Communications: Establish on-site lines of authority and communications including attendance at Pre-Construction Meeting and Progress Meetings as required by the Architect and Owner's Representative. All on-site lines of authority and communications shall be established through the Architect.
- E. The Architect and Owner's Representative, will typically be working during the Contractor's normal working hours as defined in Section 011000 - Summary. The Contractor shall anticipate that all communication and weekly construction meetings with these parties will occur between the hours of 8 a.m. and 5 p.m. Monday through Friday throughout the duration of the Project.
- F. No overtime payments will be authorized, or time delays allowed, for the Contractor or subcontractors efforts to communicate with the Architect and Owner's Representative outside of the normal working hours.

1.3 EMERGENCY COMMUNICATION

- A. Provide an Emergency Notification list to the Architect and to the Owner.

1. The Contractor shall provide a list of names, pagers, wireless and traditional telephone numbers of staff who are capable of addressing an emergency issue that may occur outside of Contractor's normal working hours. The persons designated on the list shall be available at the project site within 60 minutes of being contacted. Provide two names for each of the following:
 - a. General Contractor
 - b. Mechanical subcontractor
 - c. Electrical subcontractor
 - d. Other major subcontractors
2. Submit the list to the Architect 5 working days prior to the Preconstruction Meeting. The Architect will include the same information for design team members and Owner representatives and distribute the list at the Preconstruction Meeting.

1.4 CORRESPONDENCE

- A. All correspondence to and from Contractor will be routed through Architect with a copy to the Owner's Representative.
- B. Include project title and Architect's project number on all correspondence.

1.5 REQUEST FOR INFORMATION (RFI)

- A. It is the Contractor's responsibility to review Contract Documents in a timely manner so that the Architect shall have sufficient time to respond to a Request for Information prior to the start of actual construction of that part of the Work.
- B. When field conditions or Contract Document contents require clarification or verification by the Architect or Architect's sub-consultants, a written RFI is to be submitted as follows:
 1. Identify the nature and location of each clarification/verification using a RFI form. Provide as a minimum the following information:
 - a. Project name and number.
 - b. Date.
 - c. Date response desired.
 - d. RFI number.
 - e. Subject.
 - f. Initiator of the question (individual and firm).
 - g. Indication of costs, if known.

- h. Location on site.
 - i. Contract drawing reference.
 - j. Contract specification section and paragraph reference.
 - k. Descriptive text.
 - l. Signature of Contractor.
 - m. Attachments, including descriptive drawings, photographs, product data, submittals, dimensions, configurations, and other information needed to clarify request.
 - n. Space for reply on same page as question.
2. Number each RFI sequentially beginning with number 001 (RFI-001). Only one question per RFI.
- a. Indicate subject by designation of GEN, MECH, ELEC, CIV, or other easily identifiable discipline abbreviation.
 - b. Single subject matter, 1 item each - architectural, civil, structural, mechanical, electrical or general.
3. RFI may be hand-delivered, mailed, e-mailed or faxed, depending upon the urgency.

C. Uses

- 1. The RFI form shall be used for interpretation or clarification of the Contract Documents only.
- 2. Do not use the RFI form for the following. The Architect will not reply and the RFI will be returned without action.
 - a. Product or material substitutions (See Section 012500 - Substitution Procedures).
 - b. Questions relating to construction means, methods, techniques, sequences, procedures, or safety precautions. These are the Contractor's responsibilities exclusively.
 - c. Questions relating to construction schedule, coordination between trades, or division of work among subcontractors. These are Contractor's responsibilities exclusively.
 - d. Questions on contract administration procedural matters, unless they require interpretation or clarifications of the Contract Documents.

- e. Dimensions or quantities which are shown on the Contract Documents, which can be measured or calculated from the information contained in the Contract Documents where such measurement or calculation is standard construction industry practice.
 - f. Confirmation of interpretations or clarifications previously provided by the Architect.
 - g. The Contractor shall not initiate requests for interpretations or clarifications of the Contract Documents which can be reasonably derived from a review of the Contract Documents.
- D. Route RFI's in same manner as correspondence.
- E. Clarifications may be discussed on-site or by telephone with Architect or Architect's Consultants, with concurrence of the Architect. A summary of these discussions is to be incorporated into a RFI form and submitted as written confirmation, for normal RFI processing.
- F. Reply
 - 1. The Architect will endeavor to reply to all RFI's as promptly as his work schedule allows, and generally no later than 7 working days from the day received. The Architect and/or its sub-consultants will attempt to expedite those RFI's indicated by the Contractor as being critical to the construction schedule.
 - 2. When an RFI involves a complex subject, extensive research or governmental agency contact, the Architect will inform the Contractor that additional time is required to prepare a reply. The Contractor shall cooperate and agree to reasonable additional time.
 - 3. The reply shall be a clarification or an interpretation of the Contract Documents; the reply is not an authorization of change in the Contract Sum or Time.
 - 4. Where Architect's action may affect Contract Time or Contract Sum:
 - a. Notify Architect in writing within 10 days of receipt.
 - b. Conform to Conditions of the Contract for submittal of Change Order Proposal, Section 012600 - Contract Modification Procedures.
- G. On receipt of Architect response to RFI:
 - 1. Update RFI log and promptly distribute RFI response to those affected by response.
 - 2. Review and notify Architect within 7 days if Contractor disagrees with response.
- H. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by RFI number. Submit log weekly. Include following:

1. Project Name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including those that were dropped and not submitted.
 5. RFI description.
 6. Date RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Changes in the Work, Architect's Supplemental Instructions (ASI), Construction Change Directives (CCD), and Proposal Requests, as applicable.
- I. Note: Architect will respond only to requests for interpretation of Contract Documents originating from Contractor. The Contractor shall be deemed to be the author of all RFI's, whether written by him or one of his sub-contractors or suppliers. It is the Contractor's responsibility to ensure that all RFI's are complete and correct in form, and the Contractor shall be the contact for further information or explanation. All replies shall be directed to the Contractor, and it is his responsibility to ensure that the appropriate contractor personnel are copied or informed of the replies.

1.6 NON-COMPLIANCE NOTICE (NCN)

- A. Any work that is identified as "not in compliance" with the Contract Documents, either by oral discussion with the Contractor, or written communication to the Contractor, shall be removed and replaced without cost to the Owner, including removal of additional material necessary to confirm non-compliance. At its option, the Owner may accept written alternative solutions offered by the Contractor and recommended by the Architect. The Contractor shall notify the Architect and Owner in writing immediately following oral discussion or receipt of any written communication if the Contractor believes that the Work in question is in compliance with the Contract Documents. The Architect will make a determination based on the Contract Documents. If the Architect finds the work is in noncompliance, the Architect will issue a written Non-Compliance Notice (NCN). Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. Upon receipt of the NCN, the Contractor shall take immediate action to correct work. Review corrections at progress meetings for closure.
- B. If the Contractor fails to or refuses to comply promptly after the final determination of the appropriate corrective action, the Owner may:

1. Issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Owner will not pay for non-complying work or follow on work until the non-complying work is corrected or replaced. If it becomes necessary to stop work due to non-correction of non-complying work, no delay claim, time extension, or compensation will be granted.
2. Elect to correct the non-compliant work with his own forces, or those of another contractor, and back charge the Contractor by issuing a deductive Change Order, with appropriate explanation and supporting data, which the Contractor is required to sign. Should the Contractor elect not to sign the deductive Change Order, he will be deemed to be in breach of the contract and the dispute will be subject to the Dispute Resolution Procedures of the General Conditions.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 013115

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. Preconstruction meeting.
 - 2. Progress meetings.
 - 3. Coordination meetings.
 - 4. Pre-installation meetings.
 - 5. Commissioning meetings.
 - 6. Project closeout meetings.
 - 7. Owner training meetings.

1.2 PRECONSTRUCTION MEETING

- A. The Owner will schedule a preconstruction conference before starting construction, at a time convenient to the Contractor and the Owner, but no later than 15 days after the Notice to Proceed. The conference will be held at the Project Site or another convenient location as selected by Owner.
- B. Attendance is required of the following:
 - 1. Architect and Architect's consultants.
 - 2. Owner's Representatives.
 - 3. Contractor's Superintendent and Project Manager; Contractor's QC Representative if different individual than the Project Manager.
 - 4. Major Subcontractors.
 - 5. Others, as requested.
- C. Discussion will cover items of significance, including the following:
 - 1. Communication chain and persons authorized to direct changes.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Submission of list of Subcontractors and preliminary progress schedule per Section 013216 - Construction Progress Schedule.
 - 4. The Work.

5. Construction Team roles.
6. Work hours, sequence, phasing, and occupancy.
7. Special project procedures.
8. Procedures and processing for Application for Payments; Change Orders (CO);
9. Requests for Information (RFI); Architect Supplemental Instructions (ASI); Field decisions; Submittals; and others as appropriate.
10. Project record documents including review of as-builts on a regular basis during construction.
11. Construction facilities, and controls.
12. Temporary utilities.
13. Safety and security procedures.
14. Environmental and noise controls.
15. Housekeeping and site maintenance procedures.
16. Utility shutdowns / Outage Request Form.
17. Site Access and Parking.
18. Equipment deliveries and priorities.
19. Testing Procedures.
20. Scheduling Progress Meetings.
21. Schedule Review.
22. Contractor's Quality Control Program
23. Hazardous material abatement procedures, if any.
24. Sustainable Design Requirements (See Section 018113).
25. Draft Waste Management Plan
26. Draft IAQ Plan.
27. Use of site and premises by Owner and Contractor.
28. Requirements for start-up of equipment.
29. Inspection and acceptance of equipment put into service during construction period.

30. Others, as appropriate.

D. The Architect will:

1. Conduct the meeting to review contract administration requirements.
2. Record, produce, and distribute copies of the minutes to the Owner and General Contractor within seven (7) days of the meeting.

1.3 PROGRESS MEETINGS

- A. For purposes of coordination and scheduling after start of the work, weekly Progress Meetings will be held to enable an orderly review of the construction progress and to provide for systematic discussion and analysis of concerns that may arise relative to execution of the work.
- B. Contractor, and Subcontractors as required, shall incorporate attendance at these meetings as part of the Base Bid of the project – no overtime payments will be authorized for Contractor or Subcontractors to attend weekly Progress Meetings or other special meetings if required.
- C. Meeting Locations: ADA accessible Contractor's project field office or Owner provided meeting room, unless otherwise agreed.
- D. Attendance: Representatives attending meetings are required to be qualified and authorized to act on behalf of their firms. Attendance shall include:
 1. Architect and Architect's consultants, as appropriate.
 2. Owner's Representatives.
 3. Contractor's Superintendent, Project Manager, and QC Representative.
 4. Subcontractors, as appropriate.
 5. Suppliers, as appropriate.
 6. Others, as appropriate.
- E. Agenda: Discussion will pertain to items, such as:
 1. Attendees; list of attendees and company they represent.
 2. Review and approve minutes of previous meeting; written corrections, additions and/or deletions to previous minutes acknowledged.
 3. Review of Work in Progress: Discussion and field review.
 4. Review Short Interval Schedule.
 5. Review Outages.

6. Review construction schedule.
7. Present corrective measures and procedures to regain project schedule, as applicable.
8. Present field observations, problems, and conflicts; discuss concerns pertaining to:
 - a. Mechanical items.
 - b. Electrical items.
9. Discuss problems impeding progress schedule.
10. Planned progress during succeeding work period.
11. Review Contractor's quality control system; discuss any concerns and corrective measures.
12. Review submittal schedules and logs, present methods to expedite as required.
13. Review off-site fabrication.
14. Review delivery schedules.
15. Review outstanding RFIs.
16. Review proposed changes for:
 - a. Effect on construction schedule and on completion date.
 - b. Effect on any other contracts of the project.
17. Review Change Order Proposal log and finalize prices.
18. Review draft of Application for Payment (at end of month).
19. Confirm status of the "as-built" drawings and review required revisions to Project Record Documents; see update requirements specified below.
20. Confirm status of shop drawing submittals and approvals.
21. Review project safety.
22. Review Waste Management Plan.
23. Review any outstanding Non-Compliance Notices.
24. Review any other business.
25. Confirm next meeting date, location and time plus those requested to be in attendance.

F. Architect will:

1. Administer bi-weekly Progress Meetings throughout work progress;
 2. Record and distribute the following by e-mail within 3 working days after the meeting:
Meeting Minutes, RFI, ASI, Submittal/Shop Drawing and Cost Change logs.
Distribution to include all attendees other than those related to the General Contractor's contract. The General Contractor is responsible to distribute copies to all Contractor attendees.
 3. Provide paper copies of the minutes, RFI, ASI, Submittal/Shop Drawing and Cost Change logs to attendees at the next meeting.
 4. Ascertain that work is prosecuted consistently with contract documents and construction schedules.
- G. At Contractor's option, weekly progress meetings can be held integrally with monthly CPM Scheduling meeting specified herein.
- H. Contractor shall be responsible to provide the following at each meeting:
1. Current (and updated if necessary) Short Interval Schedule as specified in Section 013216 - Construction Progress Schedule.
 2. Current (and updated if necessary) submittal schedule.

1.4 COORDINATION MEETINGS

- A. Contractor shall hold weekly coordination meetings with his subcontractors and suppliers as deemed necessary by the Contractor for coordination of the work. Meetings shall be held on site. The Owner and the Architect will be available to attend such meetings upon request. Refer to Section 013100 - Project Management and Coordination for additional information and requirements pertaining to coordination meetings.
- B. The superintendent of the Contractor and prime subcontractors shall review the Contractor's schedule for the first three (3) months of work and thoroughly review the work required by the Contract Documents for that period. The Contractor shall submit Design Clarification Requests, Requests for Information, or any other type of information requests the Contractor may use, for the three (3) month work period during the first month after Notice To Proceed to minimize any conflicts that might occur when mobilization begins.
1. This process shall continue for each three (3) months, or increments of 3 month work segments until the completion of the Project.
- C. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.
- D. Request representation at each meeting by every trade currently involved in coordination or planning for the construction activities involved.

- E. Record meeting results and distribute copies to Architect and Owner and to others affected by decisions or actions resulting from each meeting.].

1.5 PRE-INSTALLATION MEETINGS

- A. General: Prior to commencement of work listed below or as otherwise determined by the Architect or Owner, the General Contractor or his general superintendent, the responsible foremen for the subcontractors performing said work, plus all associated sub-subcontractors, suppliers, fabricators, vendors, and others as appropriate, shall attend a meeting for the purpose of establishing a full understanding of the procedures and requirements for the orderly progress of the designated work.
- B. All subcontractors and major suppliers are required to attend these pre-installation meetings prior to commencing work of their respective specifications Section, or as required by related work in other specification sections. Contractor may elect to group several Sections or Divisions to minimize the number of these meetings.
- C. Require attendance of entities directly affecting, or affected by, work of the Section including Contractor's Project Manager and Superintendent with Lead man performing the work, and/or the appropriate Subcontractors/Suppliers/Fabricators.
- D. Contractor shall notify the Architect and Owner of the Contractor's scheduled pre-installation meeting not less than seven (7) days prior to the scheduled start of any of the work listed below so that the Architect and Owner may attend at their option. All applicable submittals as well as the Subcontractor's safety plan and insurance certificates shall have been submitted to and reviewed by the Architect and Owner prior to scheduling this meeting. Refer to individual technical sections for work requiring pre-installation meetings.
- E. Contractor will record, reproduce and distribute copies of minutes prior to the next meeting or within seven (7) days of each meeting to all meeting participants.

1.6 COMMISSIONING MEETINGS

- A. Refer to respective sections of the various general, mechanical and electrical Divisions of the Project Manual for associated commissioning meeting requirements.

1.7 PROJECT CLOSEOUT MEETINGS

- A. For the purpose of attaining project closeout, commencing immediately following established date of Substantial Completion, Contractor's project manager and superintendent and all subcontractors who have outstanding punch list items associated with their work, or as otherwise requested and including all subcontractors involved in the building systems commissioning process, shall attend weekly closeout meetings which shall be held at the jobsite.
- B. Such meetings shall be held to review and discuss the resolution of all punch list items in order to attain Final Completion. Closeout meetings shall continue on a weekly basis until all punch list items have been resolved and Final Completion is attained.

1.8 TRAINING MEETINGS FOR OPERATING INSTRUCTIONS OF OWNER'S PERSONNEL

- A. Refer to Section 017700 for training requirements related to operating instructions of Owner's personnel.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 013119

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Format for network analysis schedules.
- D. Bar chart schedules (For projects less than \$20 million).
- E. Review and evaluation.
- F. Updating schedules.
- G. Distribution.

1.2 DEFINITIONS

- A. "Day," as used throughout the Contract unless otherwise stated, means "calendar day."
- B. Float: The amount of time between the earliest finish and the latest finish date of an activity or chain of activities on the Critical Path Method (CPM) construction schedule. Float is not for the exclusive use of either the Contractor or the Owner unless otherwise identified in the Contract Documents. Extensions of time for Contract performance will be granted only to the extent that equitable time adjustments to the affected activity or activities exceed the total float time along the affected paths of the currently approved CPM at the time Notice to Proceed was issued for the change.

1.3 SUBMITTALS

- A. All schedule submittals, including schedule updates, will be reviewed jointly by the Owner/Architect and the Contractor. Such review of the Contractor's schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner. Neither the Owner's nor the Architect's review will relieve the Contractor of the sole responsibility for the accuracy, adequacy, or completeness of the schedule, the logic of the schedule, and/or completion of the Contract requirements in accord with such schedule. Neither Owner's nor Architect's review shall constitute acknowledgment that the relationships between various work items or activity durations are reasonable or appropriate.
- B. Within 10 days after date of Notice to Proceed, submit proposed preliminary diagram defining planned operations for first 60 days of Work, with general outline for remainder of Work.
- C. Participate in review of preliminary and complete diagrams jointly with Architect/Engineer.

- D. Within 20 days after joint review of proposed preliminary diagram, submit draft of proposed complete network diagram for review. Include written certification that major, mechanical and electrical Subcontractors have reviewed and accepted the proposed schedule.
- E. Submit updated schedules with each Application for Payment.
- F. Submit schedules under transmittal letter form specified in Section 013300 - Submittal Procedures. PDF method preferred.
- G. Schedule Updates:
 - 1. Overall percent complete, projected and actual.
 - 2. Completion progress by listed activity and sub-activity, to within five working days prior to submittal.
 - 3. Changes in Work scope and activities modified since submittal.
 - 4. Delays in submittals or resubmittals, deliveries, or Work.
 - 5. Adjusted or modified sequences of Work.
 - 6. Other identifiable changes.
 - 7. Revised projections of progress and completion.
- H. Narrative Progress Report:
 - 1. Submit with each monthly submission of Progress Schedule.
 - 2. Summary of Work completed during the past period between reports.
 - 3. Work planned during the next period.
 - 4. Explanation of differences between summary of Work completed and Work planned in previously submitted report.
 - 5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
 - 6. Corrective action taken or proposed.

1.4 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel specializing in CPM scheduling with two years' minimum experience in scheduling construction work of complexity comparable to the Project and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.

- B. Contractor's Administrative Personnel: two years' minimum experience in using and monitoring CPM schedules on comparable Projects.
- C. Coordination with Subcontractors and Suppliers:
 - 1. The scheduler shall prepare the Project Schedules and their updates in cooperation with major subcontractors and suppliers.
 - 2. In scheduling work of subcontractors and deliveries by suppliers, the Contractor represents that he has agreement regarding the schedule with those supplying materials and performing the work.
- D. Reliance Upon the Reviewed Schedule:
 - 1. The Progress Schedule, as reviewed by the Architect, will be an integral part of the Contract and will establish interim completion dates for the various activities under the Contract.
 - 2. Should any activity on the critical path not be completed within 15 calendar days after the stated scheduled date, the Owner shall have the right to require the Contractor to expedite completion of the activity by whatever means appropriate and necessary, without additional compensation to the Contractor. In addition, Contractor shall submit a "Recovery Schedule" which shall logically demonstrate method or methods Contractor proposes to get back on schedule within thirty (30) days of said date; i.e., additional tradespersons, shifts, work days, or crews.
 - 3. In addition to above, should any activity be 15 days or more behind schedule, the Owner shall have the right to perform the activity or have the activity performed by whatever method the Owner deems appropriate.
 - 4. Costs incurred by the Owner and the Architect in connection with expediting construction activity under this Article shall be the responsibility of the Contractor.
 - 5. It is expressly understood and agreed that failure by the Owner to exercise the option either to order the Contractor to expedite an activity or to expedite the activity by other means shall not be considered to set a precedent for any other activities.

1.5 FORMAT FOR NETWORK ANALYSIS SCHEDULE

- A. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable Specification Section number.
- B. Diagram Sheet Size: minimum 11 x 17 inches.
- C. Scale and Spacing: To allow for notations and revisions.

1.6 BAR CHART SCHEDULES (FOR PROJECTS LESS THAN \$20 MILLION)

- A. Format (Microsoft Project or approved software): Bar chart Schedule, to include at least:

1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:
 - a. Subcontract Work.
 - b. Major equipment design, fabrication, factory testing, and delivery dates including required lead times.
 - c. Preconstruction conferences.
 - d. Move-in and other preliminary activities.
 - e. Equipment and equipment system test and startup activities.
 - f. Project closeout and cleanup.
 - g. Work sequences, constraints, and milestones.
2. Listings identified by Specification Section number.
3. Identification of the following:
 - a. Horizontal time frame by year, month, and week.
 - b. Duration, early start, and completion for each activity and subactivity.
 - c. Critical activities and Project float.
 - d. Subschedules to further define critical portions of Work.

1.7 REVIEW AND EVALUATION

- A. Baseline Schedule: The initial Schedule when reviewed by the Architect and Owner shall be identified as the Baseline Schedule and shall be known as Revision 0. Each subsequent reviewed change to the Schedule shall be as a Revision numbered in sequence (Revision 1, 2, 3, etc.). The Baseline Schedule shall be submitted with no progress percentages applied to activities. The first update shall include the preliminary schedule activities and remaining activities updated as of the second monthly pay request.
- B. Participate in joint review and evaluation of schedules with Architect/Engineer at each submittal.
- C. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.
- D. After review, revise schedules incorporating results of review and resubmit within 10 days.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Scope of Preliminary Construction Schedule: The Preliminary Progress Schedule shall detail, at a minimum, all work which will be accomplished in the first 60 calendar days following the Notice to Proceed. The general approach of the balance of the work shall be indicated.
- B. Limitation on Construction:
 - 1. Mobilization and submittals can be in process during the review period.
 - 2. No construction work shall be permitted until the Preliminary Construction Schedule is submitted and reviewed.
- C. Initial Progress Payment: The first pay request will be based on the update of the preliminary schedule. This submittal shall be in the form of three (3) copies of a computer plotted timescaled logic diagram, the accompanying Microsoft Project CD, and hard copy computer reports sorted by activity number, early start and total float.

3.2 COMPLETE CONSTRUCTION SCHEDULE

- A. Progress Payments:
 - 1. Shall be withheld in the absence of a reviewed Construction Schedule.
 - 2. No adjustment or extension of time shall be granted for failure to meet the activity dates as shown. Failure to comply with these requirements shall be cause for rejection of any progress payments presented thereafter, until such time as these requirements are met.

3.3 DISTRIBUTION

- A. Copies of reviewed preliminary Construction Schedule and every reviewed revision thereof shall be submitted to the project web site for review by the: Architect, Owner and everyone whose time performance is essential to achieving the progress shown on the schedule. Notification of these updates shall be emailed to all participants with directions to access web site.

3.4 SHORT INTERVAL SCHEDULE

- A. Prepare a 3-week Short Interval (“look-ahead”) Schedule for each progress meeting. Show one (1) prior week of actual progress (planned vs actual performance). Forecast two (2) weeks of start and completion dates for each activity, task or event in comparison to the prepared schedule.
 - 1. Activities in the Short Interval Schedule shall relate directly to activities in the Construction Schedule. Each activity shall be coded with the same ID number, specification number, or other reference the contractor uses on the Construction Schedule. The Short Interval Schedule will have more detail, but each of the details must be related to the Construction Schedule coding.

2. Indicate start, on-going, intermittent and completion for each activity, task, or event.
 3. The schedule shall show critical path work, as defined by the Construction Schedule that has been affected by any changed conditions authorized through a change order or field order.
- B. Distribute paper copies of the Short Interval Schedule to all attendees at each Progress Meeting.

3.5 UPDATES

- A. General:
1. The scheduler shall attend all meetings concerning project progress, alleged delays, or time impact.
 2. The schedule shall be modified to reflect the original Contract completion date, subject to review by the Owner. Prior to submittal of the schedule update, the Contractor shall submit an advanced worksheet indicating the intended report status. The Owner, Architect and Contractor shall then meet and agree upon the completion status of the work in progress, and any major logic changes proposed by the Contractor.
 3. Maintain the Construction Schedule at the project meeting location and update weekly by drawing a line vertically through the corresponding progress of each task on the schedule as of the date of that project meeting. The line shall be in varying colors so that differentiation between weeks is readily apparent.
- B. Progress Meetings:
1. Update the reviewed Construction Schedule at each Progress Meeting.
 2. Indicate "actual" progress in percent complete for each activity.
 3. At each progress meeting discuss the Short Interval Schedule. Any deviation from the planned schedule shall be explained by Contractor, with corrective measures, if necessary, to bring progress of Work back in line with the Contract Completion date.
- C. Monthly Update:
1. Contractor shall submit an updated schedule at progress meeting following either one of the following two occurrences:
 - a. Upon completion of a major milestone; or,

- b. When the actual work completed is more than two (2) weeks behind schedule. Should the schedule show the project completion to be more than two weeks behind, the Contractor shall submit a written explanation and recovery schedule outlining corrective action taken or proposed to bring events back on schedule within a 30 day period.
- 2. Show changes occurring since previous schedule submission, such as:
 - a. Any major changes in scope, including authorized or Change Orders;
 - b. Contractor reorganization of his work sequence unrelated to changes in scope;
 - c. Activities modified since previous submission;
 - d. Revised projections for progress and completion, as applicable; and
 - e. Any other identifiable changes.
- 3. Provide narrative report as needed to define:
 - a. Problem areas, anticipated delay, and impact of these on schedule; and
 - b. Corrective action recommended and its effect.
- D. Subcontractor Participation:
 - 1. Involve all major subcontractors in preparation of the Periodic Updates of the Construction Schedule.
 - 2. Obtain approval of the schedule from each major subcontractor and submit in writing together with the Periodic Updates of the Construction Schedule.
- E. Change Orders:
 - 1. Authorized changes to the work shall be included in the schedule network as they occur in the same format and level of detail as contained in the current updated schedule. Enough activities shall be included to adequately describe the work. Code the activities in such a way that they can be identified to the specific Change Order. Insert the Change Order Activities in the network with appropriate logic ties to original network activities.
 - 2. Utilize the time impact analysis submitted with the change order to demonstrate the effect of delays on the overall project schedule.

3.6 TIME EXTENSIONS

- A. The Contractor shall notify the Owner and Architect in writing within seven (7) days of the event of any event which could delay performance or supplying of any item of the work affecting the critical path. Contractor shall indicate the expected duration of the delay, the anticipated effect of the delay on the Contractor's Construction Schedule, and the action being taken to correct the delay situation.
- B. Extensions of time to the Contractor's Contract may be granted only for delays to activities on the critical path that actually delay the Project Completion beyond the date of Substantial Completion, or for delays to activities that transform that activity onto the critical path, and as a result cause a final completion date beyond the contracted final completion date.
- C. Following receipt of an executed Change Order extending the Contract Time, the activity data and logic relationships shall be incorporated into the current detailed CPM schedule during the next scheduled progress update, as outlined above in Paragraph E "Change Orders" above. In the event the Contractor is entitled to a change in the Contract Time, the adjustment to the contract Time shall be as defined in the General Conditions.

3.7 ABNORMAL INCLEMENT WEATHER

- A. Abnormal Inclement Weather or Unusually Severe Weather: Weather which hinders or prevents work is not a basis for a time extension unless it surpasses in severity the weather reasonably to be expected in the locality at the particular time of year. If a timely notice is filed that a delay was caused by weather sufficiently severe as to entitle additional time, the Contractor is to furnish as promptly as possible thereafter a statement of the portions of the work affected, an explanation as to the reasons work was prevented or hindered by the weather if not readily apparent, the dates on which such portions of work were affected, the total number of days by which the job in its entirety was delayed and any other information which would be of assistance to support the time extension claim such as official weather bureau climatological (www.weather.gov) data for several prior years.
- B. Except for site work which may critically affect the Contract Time, no extension of time will be made for abnormal inclement weather after the principle portions of the Work are sufficiently closed-in (exterior walls up and roof in place) so as to permit any structure, or major portion thereof which is part of the Work, to be adequately heated so as to allow the various trades to perform their work.
- C. If the total calendar days lost due to abnormal inclement weather, from the start of the Work at the Project site by the Contractor until the principle portions of the Work are enclosed, exceeds the total number of days to be expected for the same period, a time extension, if granted, shall only be the number of calendar days needed to equal the excess number of calendar days lost due to such abnormal inclement weather.

END OF SECTION 013216

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following

1. Submittal procedures.
2. Construction progress schedules.
3. Proposed product list.
4. Product data.
5. Use of electronic CAD files of Project Drawings.
6. Shop Drawings.
7. Samples.
8. Other submittals.
9. Test reports.
10. Certificates.
11. Manufacturer's instructions.
12. Manufacturer's field reports.
13. Erection Drawings.
14. Construction photographs.
15. Special job-site submittals

B. Contractor review.

C. Architect/Engineer review.

D. Consent for release of electronic media.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect/Engineer's and Construction Manager's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Architect/Engineer's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Before submittal of shop drawings, brochures, and lists, Contractor shall carefully review same for proper identification, completeness, correctness, dimensions, and technical applicability to the Contract Document requirements and note all corrections, items needing clarification, additional comments, and the like. Upon thorough review and subsequent acceptance by the Contractor, if so accepted, Contractor is to note its approval together with said notes or amendments thereto for compliance with the Contract Documents by suitable stamp, date and the signature of the Contractor or its authorized representative. Submittals will be returned to the Contractor without action by the Architect if the items submitted are not stamped, signed, and identified as approved or approved as noted or other similar language indicating approval by the Contractor, or if the submittal is obviously not thoroughly reviewed.
- B. Submission of shop drawings and samples shall be accompanied by a transmittal letter containing Project name, Contractor's name, number of drawings and samples, titles and other pertinent data.
- C. Many products are specified by one or more named products/manufacturers. In those circumstances where Contractor submits an unnamed, non-prior approved product/manufacturer during this 'shop drawing' phase, said submittal shall be submitted in conformance with Section 012500 - Substitution Procedures.
- D. 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.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. 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.
 - a. The Contractor shall provide submittals requiring coordination with other submittals to the Architect at one time. The Architect will review submittals as received, provide comments, and return them to the Contractor. If the Contractor did not submit all submittals requiring coordination at the same time, and a later submittal identifies conflicts, the Contractor will be responsible for all costs associated with changes necessary to properly coordinate the installation of the materials.
 - 3. To avoid the need to delay installation as a result of the time required to process submittals, the Contractor shall anticipate the review times noted in this section and anticipate the possibility of a resubmittal or rejected submittal and the effect that action would have on the Project schedule.

- a. All required submittals shall be initially received by the Architect within 60 days following the Notice to Proceed date, or sooner as required by the following submittal review times, to meet the Construction Schedule need for materials related to the submittals. Submittals received after these time periods shall not be a cause for delay claims to the Project. Architect will not accelerate review time for submittals received after the indicated time periods, regardless of any potential impact to the Contractor's schedule.
 - b. Submittals requiring color selection and material selection are interdependent on receiving all submittals at the same time that have such selection requirements. Allow 20 working days from the date of receipt of the last such submittal by the Contractor for the Architect to complete color selections and mail out from the Architect's office.
 - c. Allow additional 5 working days for submittals requiring Architect consultant review.
 - d. For all other submittals allow 10 working days, after receipt by the Architect, to complete the initial review and mail out from the Architect's office.
 - e. If the Architect must delay processing a submittal to permit coordination with subsequent submittals, the 10 working days will begin upon receipt of the last such coordination submittal from the Contractor.
 - f. If several submittals are provided by the Contractor at the same time, allow 20 working days after receipt by the Architect to complete the initial review and respond. Provide an "Order of Priority List" to the Architect with the submittal.
 - g. If an intermediate submittal is necessary, process the same as the initial submittal.
 - h. Allow 10 working days for reprocessing each submittal after receipt unless noted otherwise.
- E. 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. Consecutively number each submittal beginning with the number 001.
- 1. Provide adequate space for the Contractor's stamp and approval, plus a space approximately 4 by 5 inches each on the label or beside the title block on Shop Drawings to record the Architect's review and approval markings and the action taken.
 - 2. Include the following information on the label or title block for processing and recording action taken.
 - a. Project name and job number.
 - b. Date.

- c. Name and address of the Architect.
 - d. Name and address of the Contractor, subcontractor, supplier and manufacturer as appropriate.
 - e. Number and title of appropriate Specification Section.
 - f. Drawing number and detail references, as appropriate.
- F. Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned through the Contractor without action. Submittals not requested will be returned unprocessed.
- 1. Address no more than one topic or related topics on a single transmittal (i.e. mechanical items shall not be submitted under same transmittal with electrical items, even though the same Contractor/subcontractor may be responsible for both).
 - 2. Record relevant information, deviations, and requests for data, including minor variations and limitations from the Contract Documents.
 - 3. Shop drawings, product data, samples, and mock-up as required for submissions by the technical specification sections are to be submitted for Architect's review/approval until "No Exception Taken" or "Make Corrections Noted" is obtained. The number of submittals required is noted in parenthesis.
 - a. Shop Drawings: (2) sets; plus one (1) additional set for Structural, Mechanical and Electrical submittals. Or one PDF if transmitted electronically (PDF method preferred).
 - b. Product Data: (2) copies; plus one (1) additional copy for Structural, Mechanical and Electrical submittals. Or one PDF if transmitted electronically (PDF method preferred).
 - c. Samples: (3) each.
 - d. Mock-ups: As required by any technical specification section.
 - e. Reference applicable mechanical and electrical technical specifications' sections for additional submittal requirements.
 - 4. Material and Color Submittal: Submit samples of actual colors of materials.
 - 5. Number submittals as follows: Numerical Order, Spec Section and Revision.
 - 6. In the event of the need to "Revise and Resubmit" a submittal, resubmit same in acceptable form/content, clearly identifying deviations from previous submittal content.

- G. Do not transmit submittals directly to Architect's consultants. Architect will review and transmit submittals to consultants for their review.
- H. Prior to submitting transmittals required by Building Code to building code officials and other Authorities Having Jurisdiction (AHJ), transmit submittals to Architect for review and approval.
- I. Maintain copy in project Field Office of each submittal, regardless of status, along with a current Submittal Log,

1.4 CONSTRUCTION PROGRESS SCHEDULE SUBMITTALS

- A. Comply with Section 013216 - Construction Progress Schedule

1.5 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation and reference standards.

1.6 PRODUCT DATA

- A. Product Data: Submit to Architect/Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit electronic submittals via email as PDF electronic files.
- C. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements and location of utility outlets for service for functional equipment and appliances.
- E. After review, distribute according to "Submittal Procedures" Article and for record documents described in Section 017000 - Execution and Closeout Requirements.

1.7 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Architect/Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy or conflict between information on electronic media and that in Contract Documents, notify Architect/Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Architect/Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation or use of this electronic information.
5. Receiver shall understand that even though Architect/Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Architect/Engineer responsible for such viruses or their consequences and shall hold Architect/Engineer harmless against costs, losses or damage caused by presence of computer virus in files or media.
7. The Contractor is to obtain a Consent for Release of Electronic Media per attached form (an electronic version of this form is available upon request). Subcontractors are to obtain this information from the Contractor and their use of the electronic files is subject to the same conditions.

1.8 SHOP DRAWINGS

- A. Shop Drawings: Submit to Architect/Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit drawings drawn to accurate scale. Shop drawings are not intended to change the design. Do not reproduce Contract documents or copy standard information for use as Shop Drawings. Standard information prepared without specific references to the project is not a Shop Drawing.
- C. Provide fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
 1. Dimensions.

2. Identification of products and materials included.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurements.
 6. Any deviation from contract drawings or specifications.
 7. Date when review has to be finalized to meet schedule.
- D. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
1. Include signed and sealed calculations to support design.
 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- F. All items shown on shop drawings that do not conform to plans and specifications shall be specifically noted as such (flagged) and brought to the Architect's attention. In any case, the Architect's stamp of review shall not include approval of unauthorized changes in the Contract Documents, except where specific written approval is given.
- G. Contractor is responsible for obtaining and distributing required shop drawings to its subcontractors and material suppliers after, as well as before, final review by the Architect. Prints or PDF's of reviewed shop drawings shall be made from approved submittals which carry the Contractor's and Architect's appropriate stamps. Architect/Owner and applicable consultants and AHJ shall retain copies of each shop drawing submittal.
- H. Submit electronic submittals via email as PDF electronic files.

1.9 SAMPLES

- A. Samples: Submit to Architect/Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
1. Submit to Architect/Engineer for aesthetic, color and finish selection.
 2. Submit Samples of finishes, textures and patterns for Architect/Engineer selection.

- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
 - 1. Where variation in color, pattern, texture or other characteristics are inherent in the material, submit not less than four (4) units to show approximate limits of the variations.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of samples specified in individual Specification Sections; Architect/Engineer may retain one sample.
- F. Reviewed Samples, which may be used in the Work, are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. Unless noted otherwise in the relevant technical section of these specifications, remove all samples and mock-ups from the project site, after review and approval by the Owner and Architect.

1.10 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 017000 - Execution and Closeout Requirements.

1.11 TEST REPORTS

- A. Informational Submittal: Submit reports for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.12 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Architect/Engineer.

1.13 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Architect/Engineer's knowledge as Contract administrator or for Owner.

- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Architect/Engineer in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.14 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit a PDF report within 5 days of observation to Architect/Engineer for information unless it is needed sooner.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.15 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.16 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of Site and construction throughout progress of Work produced by an experienced photographer acceptable to Architect/Engineer.
- B. Submit photographs with Application for Payment.
- C. Take sufficient Site photographs from different directions and sufficient interior photographs indicating relative progress of the Work, 5 days maximum before submitting pay request, to confirm progress.
- D. Identify each print on back, identify digital prints with file name. Identify name of Project, contract number, orientation of view, date and time of view and photographer's numbered identification of exposure.
- E. Digital Images: Deliver complete set of digital image electronic files on CD-ROM or other approved media to Architect with project record documents. Identify electronic media with date photographs were taken (not necessary on digital prints). Submit images that have same aspect ratio as sensor, uncropped.

1. Digital Images: Uncompressed JPG or other approved format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and image resolution of not less than 1024 by 768 pixels.

1.17 SPECIAL JOB-SITE SUBMITTALS

A. Hazardous Chemical Inventory:

1. In order to comply with the State of Washington's Hazard Communication Standard (Chapter 296-800-170 WAC), the Owner requires the Contractor to provide a complete inventory of all potentially hazardous chemicals which the Contractor (including subcontractors) will bring into or produce at the work site. This inventory shall be submitted to the Architect no later than three days prior to the chemicals arrival on site. Specific information for each chemical, in the form of Material Safety Data Sheets (MSDS), and the personal protective equipment required for working with the materials (respirators, special clothing, etc.) shall be included in the submittal.
2. The Contractor shall revise this information as necessary (i.e. when new chemicals are brought onto or produced at the worksite), with updates forwarded to the Architect. A complete and accurate copy of this information shall be immediately available at the Contractor's worksite office for reference by Owner representatives and the Contractor's employees during the Contractor's working hours.

B. Submit revised inventory monthly or whenever changes are made.

1.18 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Architect/Engineer.
- B. Contractor: Responsible for:
1. Determination and verification of materials including manufacturer's catalog numbers.
 2. Determination and verification of field measurements and field construction criteria.
 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 4. Determination of accuracy and completeness of dimensions and quantities.
 5. Confirmation and coordination of dimensions and field conditions at Site.
 6. Construction means, techniques, sequences and procedures.
 7. Safety precautions.
 8. Coordination and performance of Work of all trades.

- C. Stamp, sign or initial and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Architect/Engineer.

1.19 ARCHITECT/ENGINEER REVIEW

- A. Do not make "mass submittals" to Architect/Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 20 or more submittals or items in one week. If "mass submittals" are received, Architect/Engineer's review time stated above will be extended as necessary to perform proper review. Architect/Engineer will review "mass submittals" based on priority determined by Architect/Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Architect/Engineer's information, do not require Architect/Engineer's responsive action and will not be reviewed or returned with comment.
- C. Submittals made by Contractor, which are not required by Contract Documents, may be returned without action.
- D. Architect review of submittals does not relieve the Contractor from his responsibilities for conformance with the Contract Documents, proper installation, compliance with applicable codes, or coordination of the Work.
- E. Submittal approval does not authorize changes to Contract requirements unless accompanied by: Change Order, Architect's Supplemental Instruction, Field Order, Substitution Request or Construction Change Directive.
- F. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.
- G. The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be marked to indicate the action to be taken.
- H. The Architect will distribute the reviewed submittals to:
 - 1. Architect project file and/or Owner.
 - 2. AHJ (as required)
 - 3. Architect sub-consultants.
 - 4. Contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 013300

CONSENT FOR THE RELEASE OF ELECTRONIC MEDIA

Project:	Longview School District HVAC Chiller Replacements and Indoor Air Quality Improvements	Recipient:	
Architect's Project No.:	22220.00	Date:	

The Recipient and the Architect hereby approve the release of electronic media as follows:

1. The Recipient agrees, to the fullest extent permitted by law, to indemnify and hold the Architect and its Consultants harmless from any damage, liability, or cost, including reasonable attorney's fees and cost of defense arising from any reuse or modifications of the electronic media by the Recipient or any person or entity which acquires or obtains the electronic media from or through the Recipient. In no event shall the Architect or its Consultants be liable for any loss of profit or any damages.
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3. Files are recognized to be subject to alteration, degradation, erosion and erasure. The Recipient is advised to check all electronic media for computer viruses before loading the files. The Recipient agrees to indemnify and hold harmless the Architect and its Consultants from and against all claims of any kind put forth by the Recipient or others as a result of inadvertent viruses transmitted with the electronic files.
4. The electronic files are provided as a convenience to the Recipient and are not considered the Contractual Instruments of Service nor considered "Contract Documents" or "Drawings of Record" or "Construction Documents" or "As-Built Drawings."
5. The Architect and Consultants shall be deemed the authors of the transferred media, and will retain all common law, statutory and other reserved rights, in addition to the copyright. Each party shall have the right to alter, modify or delete materials without consequence to the other party, as long as the changes are not attributed to the other party.
6. The information is for use on this project only and not to be used for other purposes.
7. Recipient agrees to compensate Architect and Consultant reasonable costs for preparation of the electronic files as agreed upon.

Approved by Owner:			
Name:		By:	
Date:		Title:	
Approved by Architect:		Accepted by Recipient:	
Name:	Integrus Architecture, P.S.	Name:	
By:		By:	
Title:		Title:	
Date:		Date:	

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction Indoor Air Quality (IAQ) Management Plan.
2. HVAC air filters.
3. Building flush-out.
4. Indoor air quality testing.

B. Related Sections:

1. Section 018113 - Sustainable Design Requirements: General LEED requirements.
2. Section 019100 - Commissioning: General commissioning requirements.
3. Section 234000 - HVAC Air Cleaning Devices: Permanent air filters.

1.2 REFERENCES

A. American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE):

1. ASHRAE 52.2 - Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.

B. Sheet Metal and Air Conditioning National Contractors Association (SMACNA):

1. SMACNA IAQ 2nd Edition 2007 - Guideline for Occupied Buildings under Construction, Chapter 3: Control Measures.

C. U.S. Environmental Protection Agency (EPA):

1. EPA IAQ Testing - Compendium of Methods for the Determination of Air Pollutants in Indoor Air.

1.3 PLAN REQUIREMENTS

A. Intent:

1. Prevent indoor air quality problems resulting from construction [and renovation] process.
2. Protect HVAC system during construction [and renovation], control pollutant sources, and interrupt contamination pathways.

PART 2 PRODUCTS

2.1 HVAC AIR FILTERS

- A. Return Filters: Filtration media rated for minimum efficiency reporting value (MERV) when tested according to ASHRAE 52.2.
 - 1. Construction Return Filters: MERV of 8.
 - 2. Flush-Out Return Filters: MERV of 13.
 - 3. Permanent Filters: As specified in Section 234000 - HVAC Air Cleaning Devices.
- B. Supply Filters: As specified in Section 234000 - HVAC Air Cleaning Devices.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES - GENERAL

- A. Prevent the absorption of moisture and humidity by absorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area or into building HVAC system.
- E. All tools and equipment used within a building return air space shall be equipped with a filter system to reduce the introduction of particulate and odor into the return air.
- F. Fabricated products shall be pre-finished off-site wherever practical and to the greatest extent possible. The use of spray equipment for applying finishes in buildings shall be used only upon approval of Owner.
- G. Do not store construction materials or waste in mechanical or electrical rooms.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. During installation of carpet, resilient flooring, paints, furnishings, and other VOC emitting products, provide supplemental (spot) ventilation for at least 72 hours after work is completed and describe these activities in the weekly reports.

- J. Operate HVAC with supply air system only and use exhaust fans to remove air outside of ducted system to avoid contaminating return air ducts.
- K. Conduct regular inspection and maintenance of indoor air quality measures, including ventilation system protection and ventilation rate.
- L. Require VOC safe masks for workers installing VOC emitting products (interior and exterior) defined as products that emit 150 g/L or more.
- M. Use low-toxic cleaning supplies for surfaces, equipment, and worker's personal use.
- N. When dry sanding for gypsum board assemblies, provide the following protection:
 - 1. Isolate the space.
 - 2. Provide plastic sheet separation during sanding.
 - 3. Close and seal all air system devices and ductwork.
 - 4. Sequence construction to avoid contamination of other spaces with gypsum dust.
 - 5. Provide worker protection.

3.2 FILTER INSTALLATION AND REPLACEMENT

- A. Install construction return filter at each return grille before operating permanent air handlers during construction.
- B. Replace filters after completing construction and before conducting building flush-out.
 - 1. Replace construction return filters with flush-out return filters.
 - 2. Replace supply filters.
- C. Replace filters after conducting building flush-out and before occupancy.
 - 1. Replace flush-out return filters with permanent filters.
 - 2. Replace supply filters.

3.3 BUILDING FLUSH-OUT

- A. The Contractor shall include a separate milestone date on the CPM Schedule, which indicates the targeted date(s) for start of building flush out process.
- B. Conduct building flush-out after construction ends and before occupancy.
 - 1. Operate HVAC air systems using 100 percent outside air for two weeks, minimum.

2. Operate HVAC air system to supply 14,000-cu ft/sq ft floor area (4,274-cu m/sq m floor area) total outdoor air volume while maintaining 60 degrees F (15.5 degrees C) minimum indoor temperature and 60 percent maximum indoor relative humidity.
3. Operate HVAC air system to supply minimum of 3,500-cu ft/sq ft floor area (1,068-cu m/sq m floor area) total outdoor air volume to spaces before occupancy is permitted.

3.4 IAQ MANAGEMENT PLAN IMPLEMENTATION

- A. The Contractor is required to implement and maintain the approved IAQ Management Plan for the duration of the Project, and to update procedures at any time due to unanticipated building conditions.
- B. Provide reports and photographs of construction IAQ management measures such as protection of ducts and on-site stored or installed absorptive materials. In each report describe and illustrate IAQ measures (installation, effectiveness, upkeep, etc.) during construction along with a description of the SMACNA approach employed.
 1. Provide data sheets of filtration media used during construction and installed immediately prior to building flush out and prior to building occupancy.

3.5 CONSTRUCTION PHOTOGRAPHS

- A. Section 013300 - Submittal Procedures: Requirements for construction photographs.
- B. Photograph construction operations to show compliance with SMACNA IAQ and Construction IAQ Management Plan.
 1. Take minimum of six photographs on minimum of three different occasions during construction to show consistent adherence with specified requirements.
 2. Identify photographs as required in Section 013300 - Submittal Procedures and identify SMACNA IAQ approach illustrated in each photograph.

3.6 FIELD QUALITY CONTROL

- A. Section 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Conduct baseline indoor air quality testing procedure according to EPA IAQ Testing.
 1. Verify indoor air contaminants do not exceed the following limits:

CONTAMINANT	MAXIMUM CONCENTRATION
Formaldehyde	27 parts per billion
Particulates (PM10)	50 micrograms per cubic meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter

4-Phenylcyclohexene (4-PCH)	6.5 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million and no greater than 2 parts per million above outdoor levels

- C. Conduct air sample testing according to the following:
1. Verify interior finishes, including but not limited to millwork, doors, paint, carpet and acoustic tiles, are installed. [Verify movable furnishings such as workstations and partitions are installed.]
 2. Test air quality before occupancy, during normal occupied hours, with building ventilation system starting at normal daily start time and operated at minimum outside air flow rate for occupied mode for duration of air testing.
 3. Test air quality for each portion of building served by separate ventilation system, using minimum one sampling point for each 25,000 sq ft (2,323 sq m), or one sampling point for each contiguous floor area, whichever is larger. Include sampling points in areas with least ventilation and greatest presumed contaminant source strength as directed by [Architect/Engineer] [Owner].
 4. Collect air samples between 3 and 6 feet (900 and 1800 mm) above finished floor. Collect samples over minimum 4-hour period.
- D. When tests indicate contaminants exceed maximum concentration limit, flush affected building area with outside air and retest.
1. Repeat flushing and retesting until measured contaminant concentrations are less than specified maximum limits.
 2. Take air samples for retests at same location as initial tests.

3.7 REMOVAL

- A. Remove all IAQ measures as well as signs, framing, and supports at completion of project. If an IAQ measure may, in the Contractor's opinion, remain confirm this in advance with the Owner's Representative before leaving it in place.
- B. All testing, adjusting and balancing of systems, including training of Owner's designated personnel, shall be completed after the flush out period. All flush out filtration media must be replaced with required filtration media prior to testing and adjusting of systems.
- C. Actual procedures which are followed during building flush out must receive prior approval from Owner and Architect.
- D. Punch list items which do not affect the mechanical systems may be conducted during this flush out period upon approval of the Owner and Architect.

- E. Upon completion of building flush out, replace all filtration media with MERV 13 filters as determined by ASHRAE 52.2-1999, except the filters solely processing outside air.
- F. Submit a report upon completion of building flush out stating that all procedures stated in the approved IAQ Management Plan have been complied with. This report shall contain all [weekly] reports and photographs, as well as any IAQ management plan activities which occurred during the project. Submit in one (1) 3-ring binder with compact disk (CD) copy in MS Word.

END OF SECTION 013536

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Mockup requirements.
- F. Testing and inspection services.
- G. Manufacturers' field services.

1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
- D. Perform Work using persons qualified to produce required and specified quality.
- E. Products, materials, and equipment may be subject to inspection by Architect/Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- F. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.
- G. Maintain project superintendent continually on Project site for duration of Work of this Contract. Do not engage project superintendent in work other than Work of this Contract.
- H. Comply fully with manufacturers' instructions, including each step in sequence.

1. Should manufacturers' instructions conflict with Contract Documents; request clarification from Architect before proceeding.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within thirty (30) days of date established for the Notice to Proceed.
 1. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.
- D. Allow tolerances for thermal expansion and effects of mechanical vibration.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference in reference documents.

- F. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade and Professional Associations of the U.S.," which are available in most libraries or a search engine dedicated to construction industry data such as <http://www.4specs.com> or <http://www.arcat.com>.

1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
1. Model number.
 2. Serial number.
 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.
- B. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mockups shall be comparison standard for remaining Work.
- D. Where mockup has been accepted by Architect/Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Architect/Engineer.

1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection.
- B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Architect/Engineer, Owner or authorities having jurisdiction.

1. Laboratory: Authorized to operate at Project location.
 2. Laboratory Staff: Maintain full-time specialist on staff to review services.
 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Reports shall be submitted by independent firm to Architect/Engineer, Contractor and authorities having jurisdiction, in PDF format indicating observations and results of tests and compliance or noncompliance with Contract Documents.
1. Submit final report indicating correction of Work previously reported as noncompliant.
- D. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- E. The Contractor shall arrange and pay for all inspection and testing required by the Contract Documents except for tests specifically indicated herein as the responsibility of the Owner. The Contractor shall also be responsible for all costs of all inspections and testing including, but not limited to, the following:
1. Re-inspection and/or retesting of Owner provided inspections or testing due to failure.
 - a. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Architect/Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
 2. Testing required because of changes in materials or proportions at the request of the Contractor.
 3. Contractor's duties for owner provided inspections and tests, as specified.
- F. Agency Responsibilities:
1. Test Samples of mixes submitted by Contractor.
 2. Provide qualified personnel at Site. Cooperate with Architect/Engineer and Contractor in performance of services.
 3. Perform indicated sampling and testing of products according to specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Architect/Engineer and Contractor of observed irregularities or nonconformance of Work or products.

6. Perform additional tests required by Architect/Engineer.
7. Attend preconstruction meetings and progress meetings.
- G. Agency Reports: After each test, promptly submit PDF copies of report to Architect/Engineer, Contractor, and authorities having jurisdiction. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
 1. Date issued.
 2. Project title and number.
 3. Name of inspector.
 4. Date and time of sampling or inspection.
 5. Identification of product and Specification Section.
 6. Location in Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
- H. Limits on Testing Authority:
 1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment and commissioning as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer is subject to approval of Architect/Engineer.

- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 013300 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project Site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 ACCEPTABLE TESTING AGENCIES

- A. Testing Agency used to be approved by Owner and Architect.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Comply with the Contract Document requirements. See Section 017000 – Execution and Closeout Requirements.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:

1. Protection of Existing Utilities.
2. Temporary Utility Installation.
3. Temporary power
4. Temporary lighting for construction purposes.
5. Temporary heating.
6. Temporary cooling.
7. Temporary ventilation.
8. Communication services.
9. Temporary water service.
10. Temporary sanitary facilities.

B. Construction Facilities:

1. Field offices and sheds.
2. Vehicular access.
3. Parking.
4. Progress cleaning and waste removal.
5. Project identification.
6. Traffic regulation.
7. Fire-prevention facilities.

C. Temporary Controls:

1. Barriers.
2. Traffic and Pedestrian Obstructions.
3. Enclosures and fencing.
4. Security.

5. Water control.
 6. Dust control.
 7. Erosion and sediment control.
 8. Noise control.
 9. Pest and rodent control.
 10. Pollution control.
 11. Hazardous Material Spills
- D. Removal of utilities, facilities, and controls.
- E. Covid Protocols and Procedures.

1.2 PROJECT CONDITIONS

- A. Temporary Utilities: Within 15 calendar days of the Notice to Proceed, the Contractor shall submit to the Architect and Owner a schedule and a location sketch indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on site.

1.3 PROTECTION OF EXISTING UTILITIES

- A. Concealed utilities of record are shown on Drawings. These are not necessarily exact with respect to location or completeness. Contractor to coordinate utility locates prior to excavation.
- B. Notify Owner in writing, on each occasion, of intent to work near or on existing underground utility services or structures that may affect Owner occupied portions of Project Site. Submit procedure for safe and continuous operation of services. Do not proceed prior to approval.
- C. Proceed with sufficient caution to preclude damaging utilities known or unknown. In event unidentified utilities are encountered, promptly notify Owner.
- D. In the event Owner's utilities are damaged during construction, promptly provide temporary services and make repairs to maintain continuity of services at the Contractor's expense.

1.4 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
 - 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner. The Owner will not accept cost or use charges as a basis of claims for Change Orders.

1.5 TEMPORARY POWER

- A. Temporary power can come from the existing building and the Contractor will not be charged.
- B. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters and main distribution switchgear.
 - 1. Install electric power service underground, except where overhead services must be used.
 - 2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
- C. Complement existing power service capacity and characteristics as required for construction operations.
- D. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- E. Provide main service disconnect and overcurrent protection at convenient location.
- F. Permanent convenience receptacles may be used during construction. Replace any damaged receptacles caused by this use.

1.6 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain lighting for construction operations to achieve minimum lighting level of 2 watts/sq ft.
- B. Provide and maintain after dark for security purposes.
- C. Provide and maintain HID lighting to interior work areas after dark for security purposes.
- D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, lamps, and the like, for adequate lighting levels.
- E. Maintain lighting and provide routine repairs.
- F. Permanent building lighting may be used during construction with Owner approval. Re-lamp all fixtures used for temporary lighting at substantial completion and provide documentation.

1.7 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Enclose building before activating temporary heat according to "Enclosures and Fencing" Article in this Section.
- C. Before operating permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.
- D. Where construction is in progress, provide a dust free atmosphere and heating for curing, reducing moisture and humidity and suitable temperatures for installation of specified products unless indicated otherwise in specifications. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.
- E. Portable Heaters: Electric, non-combustion, forced air fan units complete with controls, acceptable to Owner and Architect. Use of heaters that generate moisture or hazardous fumes are prohibited.

1.8 TEMPORARY COOLING

- A. Existing cooling systems shall not be used during construction.
- B. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations

1.9 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity and to prevent accumulation of dust, fumes, vapors or gases.
- B. When hazardous chemicals, mineral-spirit based paints, adhesives, or other similar materials are used, the Contractor shall exhaust toxic, noxious, or odor producing fumes from the building. Method of exhaust shall ensure safety of building occupants and pedestrians in and around the project site. All existing building supply and return air ductwork within the construction area shall be capped air-tight to prevent distribution of fumes throughout the building.
- C. Replace filters, clean and lubricate system prior to acceptance by Owner.

1.10 COMMUNICATION SERVICES

- A. Post in field office a list of important telephone numbers.
 - 1. Police and fire departments.
 - 2. Ambulance service.
 - 3. Contractor's home office.
 - 4. Architect's office.
 - 5. Owner's Office.
 - 6. Principal subcontractors' field and home offices.
- B. Provide mobile telephone for superintendent's use, to be operational and kept on his/her person at all times during working hours under this contract.
- C. Internet Service: Provide, maintain, and pay for broadband Internet service to field office at time of Project mobilization. Provide desktop computer with Microsoft operating system and appropriate office function software, and printer.

1.11 TEMPORARY WATER SERVICE

- A. Provide for suitable quality water service as needed to maintain specified conditions for construction operations. Connect to existing water source if applicable. Owner will pay for existing water service.
- B. Install the temporary water service as soon as practicable to provide for the use of this service by all trades. Provide 3/4 inch hose bibs for temporary water needs as required.
- C. Drinking Water: General Contractor to furnish from a proven safe source for all those connected with the work. Pipe or transport in such manner as to keep it clean and fresh. Serve in single service containers or by sanitary drinking fountains.

- D. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation and heat tape to prevent freezing.

1.12 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization.

1.13 FIELD OFFICES AND SHEDS

- A. Provide Field Office: Weathertight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture including: conference table, drawing rack, filing cabinets and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate ten persons.
- C. Locate field offices and sheds a minimum distance of 30 feet from existing and new structures.
- D. When permanent facilities are enclosed with operable utilities, relocate field offices and storage into building, with written agreement of Owner, and remove temporary buildings.
- E. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
 - 1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures when no longer needed.
 - 2. Thermal Resistance of Floors, Walls and Ceilings: Compatible with occupancy and storage requirements.
 - 3. Exterior Materials: Weather-resistant, finished in color acceptable to Architect/Engineer.
 - 4. Interior Materials in Field Offices: Sheet-type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
 - 5. Lighting for Field Offices: 50 ft-C at desktop height; exterior lighting at entrance doors.
 - 6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.
- F. Environmental Control:
 - 1. Heating, Cooling and Ventilating for Offices: Automatic equipment to maintain comfort conditions.

- G. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and inspection of products to suit requirements in Section 016000 - Product Requirements.
- H. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.
- I. Installation:
 - 1. Install field office spaces ready for occupancy 15 days after date established by Notice to Proceed.
 - 2. Employee Residential Occupancy: Not allowed on Owner's property.
- J. Maintenance and Cleaning:
 - 1. Weekly janitorial services for field offices; periodic cleaning and maintenance for sheds and storage areas.
 - 2. Maintain walks free of mud, water, snow and the like.
- K. Removal: At completion of Work remove buildings, foundations, utility services and debris. Restore areas to same or better condition as original condition.

1.14 VEHICULAR ACCESS

- A. Construct temporary access roads from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.
- D. Locate as approved by Architect/Engineer.
- E. Provide unimpeded access for emergency vehicles. Maintain 20 foot wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants and control valves free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets to AHJ standards.
- H. Use designated existing on-Site roads for construction traffic.

1.15 PARKING

- A. Locate as approved by Architect/Engineer.

- B. If Site space is not adequate, provide additional off-Site parking.
- C. Use of designated areas of existing parking facilities used by construction personnel is permitted.
- D. Do not allow heavy vehicles or construction equipment in parking areas.
- E. Designate one parking space for Architect/Engineer/Owner's Representative.
- F. Permanent Pavements and Parking Facilities:
 - 1. Bases for permanent roads and parking areas may be used for construction traffic.
 - 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.
- G. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice and the like.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water and other deficiencies, to maintain paving and drainage in original condition.
- H. Removal, Repair:
 - 1. Remove temporary materials and construction at Substantial Completion.
 - 2. Remove underground Work and compacted materials to depth of 2 feet; fill and grade Site as indicated.
 - 3. Repair facilities damaged by use, to original condition.

1.16 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces, before enclosing spaces.
- C. Broom and vacuum clean interior areas before starting surface finishing and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site weekly and dispose of off-Site.
- E. Provide adequate storage for all items, awaiting removal from the job site, observing all requirements for fire prevention and protection of the ecology

- F. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
- G. Dispose of flammable, hazardous and toxic waste materials on daily bases. Do not permit storage inside buildings.
- H. Provide vehicles to haul materials off site that are constructed and loaded so as to prevent any leaking of materials from the vehicle (RCW 46.61.655). Keep sidewalks, lawns, parking areas and streets clear of all construction materials, debris, gravel, rock and dirt attributed to the General Contractor or the sub-contractors. Clean up these areas on a daily and/or "upon request" basis as determined by the Architect's representative.

1.17 PROJECT IDENTIFICATION

- A. Project Identification Sign:
 - 1. One sign, 32-sq ft area, with bottom at 6 feet above ground.
 - 2. Content:
 - a. Project title and name of Owner.
 - b. Names and titles of authorities.
 - c. Names and titles of Architect/Engineer and Consultants.
 - d. Name of Prime Contractor and major Subcontractors.
 - 3. Graphic Design, Colors, and Style of Lettering: approved by Architect/Engineer.
- B. Project Informational Signs:
 - 1. Informational signs of same colors and lettering as Project identification sign or standard products; size lettering for legibility at 100-foot distance.
 - 2. Provide sign at each field office and storage shed and provide directional signs to direct traffic into and within Site. Relocate as Work progress requires.
 - 3. No other signs are allowed without Owner's permission except those required by law.
- C. Design sign and structure to withstand 60-mph wind velocity.
- D. Sign Company: Experienced as professional sign manufacturer/installer for minimum of three years.
- E. Finishes, Painting: Adequate to withstand weathering, fading and chipping for duration of construction.
- F. Sign Materials:

1. Structure and Framing: structurally adequate.
2. Sign Surfaces: Exterior grade plywood with medium-density overlay, minimum of 3/4 inches thick, standard large sizes to minimize joints.
3. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
4. Lettering: Precut vinyl self-adhesive products, white.

G. Installation:

1. Install Project identification sign within 15 days after date established by Notice to Proceed.
2. Erect at approved location of high public visibility adjacent to main entrance to Site.
3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
4. Install sign surface plumb and level, with butt joints. Anchor securely.
5. Paint exposed surfaces of sign, supports and framing.

H. Maintenance: Maintain clean signs and supports; repair deterioration and damage.

I. Removal: Remove signs, framing, supports and foundations at completion of Project and restore area.

J. No other signs are allowed without Owner permission except those required by law.

1.18 TRAFFIC REGULATION

A. Signs, Signals, and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
2. Traffic Control Signals: As approved by local jurisdiction.
3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
4. Flag Person Equipment: As required by authorities having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:

1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
 2. Confine construction traffic to designated haul routes.
 3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.
- E. Traffic Signs and Signals:
1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
 2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
 3. Relocate signs and signals as Work progresses, to maintain effective traffic control.
- F. Removal:
1. Remove equipment and devices when no longer required.
 2. Repair damage caused by installation.
 3. Remove post settings to depth of 2 feet, compact and finish to match adjacent grade.

1.19 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Tobacco products are not permitted on grounds and construction site during the Work of this Contract.
- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Standpipes: Install minimum of one standpipe for use during construction before building reaches 40 feet in height.
- D. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
 2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
 3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

1.20 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way.
- C. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

1.21 TRAFFIC AND PEDESTRIAN OBSTRUCTIONS

- A. Provide signs and/or flag-persons in accordance with WAC 296-155-305 and RCW 47.36.200 for deliveries or operations which obstruct traffic in the street.
- B. Contractor's equipment located on sidewalks or other pedestrian ways shall be suitably barricaded for cane detection as a warning for sight impaired persons. Barricade shall include a horizontal member at a maximum of two feet above the walking surface.
Pedestrian traffic will be diverted with appropriate signs, barricades, fences, etc., from any area where contractor equipment or operations may pose a threat to the safety and health of passing pedestrians.

1.22 ENCLOSURES AND FENCING

- A. Construction: approved Contractor's option.
- B. Provide 6-foot-high fence around construction Site; equip with vehicular gates with locks.
 - 1. Post fence with "Danger Hard Hat Area" signs at maximum 50 foot centers.
- C. Exterior Enclosures:
 - 1. Provide temporary insulated, weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- D. Interior Enclosures:
 - 1. Provide temporary partitions and ceilings as required to prevent damage to existing materials and equipment.

1.23 SECURITY

- A. Security Program:
 - 1. Protect Work on existing premises and Owner's operations from theft, vandalism, and unauthorized entry.

2. Initiate program at Project mobilization.
3. Maintain program throughout construction period until directed by Architect/Engineer.

1.24 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.
- B. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.25 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

1.26 NOISE CONTROL

- A. Provide methods, means and facilities to minimize noise produced by construction operations to level required by AHJ.

1.27 PEST AND RODENT CONTROL

- A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.28 POLLUTION CONTROL

- A. Comply with pollution and environmental control requirements of authorities having jurisdiction.
- B. The Contractor shall exercise every reasonable precaution to protect channels, storm drains, and bodies of water from pollution and shall conduct and schedule its operations so as to minimize or avoid muddying and silting of said channels, drains, and waters. Water pollution control work shall consist of constructing those facilities which may be required to provide prevention, control, and abatement of water pollution. Provide a Stormwater Pollution Prevention Plan (SPPP) as required by the Washington State Department of Ecology. Submit for approval to DOE and make corrections required. Pay the permit fee required by DOE.

1.29 HAZARDOUS MATERIALS SPILLS

- A. If hazardous materials are released on the construction premises, a record of type of materials spilled, quantity, containment, cleanup, decontamination and disposal mechanisms used, reports made to regulatory agencies, and records of regulatory agency activity, if any, shall be kept by the Contractor and provided to Architect.
- B. Contractor and all subcontractors shall immediately report all spills of hazardous materials to Architect.
- C. The Contractor shall be responsible for spill containment, regulatory reporting, cleanup, decontamination, and waste disposal which meets WAC 173-340 and 173-303. See Section 017419 - Construction Waste Management, "Dangerous Waste Management," for additional information regarding disposal of hazardous materials.

1.30 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities and materials before Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.31 COVID PROTOCOLS AND PROCEDURES

- A. Contractors shall comply with all federal, state, and local mandated Covid protocols and requirements for worker and job site safety as identified by Washington State governing agencies.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 015000

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Damaged Products.
- F. General Product Requirements
- G. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
 - 1. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - 2. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Comply with delivery requirements in Section 017419 - Construction Waste Management and Disposal.

- B. Schedule delivery of products affecting Progress Schedule critical path to complete project within time of completion stated in the Agreement. Associated cost increases due to failure to meet accelerated delivery schedules and deliveries of long lead time products are responsibility of Contractor.
- C. Coordinate to avoid conflict with work and site conditions. Limit long term site storage, overcrowding of limited storage space, and conflict with available equipment and personnel for handling Products.
- D. Coordinate delivery to limit storage time for Products that are flammable, hazardous, easily damaged, subject to deterioration, or liable for theft or loss.
- E. Transport and handle products according to manufacturer's instructions.
- F. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide bonded off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT HANDLING REQUIREMENTS

- A. Provide equipment and personnel necessary to handle Products, including those furnished by Owner, by methods to prevent soiling, damage, or loss of Products and protective packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring, and other damage to Products and surrounding surfaces.
- C. Handle Products by methods to prevent bending or overstressing.
- D. Lift heavy components only at designated lifting points.

1.6 DAMAGED PRODUCTS

- A. Promptly remove damaged and deteriorated Products from premises. Replace with new undamaged materials conforming to Contract Documents.

1.7 PRODUCT OPTIONS

- A. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 012500 - Substitution Procedures.

PART 2 PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 - 2. Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar application.
 - 3. Color and Appearance Consistency of Finish Materials: All finish materials of their respective kinds, in regards to construction phasing, shall be consistent in color and appearance throughout the total Project and shall be purchased out of one dye lot, production run, batch, etc., as applicable, for the total Project for each respective material.
- B. Additional Requirements: Material and equipment incorporated in to the work:
 - 1. Shall conform to applicable specifications and standards.
 - 2. Shall comply with size, make, type and quality specified or as specifically approved in writing by Architect.
 - 3. Shall be free of ASBESTOS, FORMALDEHYDE and LEAD.

4. Manufactured and Fabricated Products:

- a. Manufacture like parts of duplicate units to standard sizes and gauges; parts to be interchangeable.
- b. Two or more items of the same kind to be identical and by same manufacturer (whether furnished under one Section or more).
- c. Products shall be suitable for service conditions. Adhere to indicated equipment capacities, sizes, and dimensions unless variations are specifically approved in writing.
- d. Except where field finishing is specified or otherwise required, products and fabricated items shall be pre-finished off-site.
- e. Do not use materials and equipment for other than designed or specified purposes and uses.

2.2 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
- B. Cord and Plug: Furnish minimum 6-foot long cord and plug including grounding connector for connection to electric wiring system. Cord of longer length may be specified in individual Specification Sections or required for actual connection.

PART 3 EXECUTION - NOT USED

END OF SECTION 016000

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Starting of systems.
- B. Testing, adjusting, and balancing.
- C. Project record documents.
- D. Execution Cutting and patching.
- E. Special Procedures
- F. Protecting installed construction.

1.2 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Architect/Engineer seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- I. Starting Systems: The Commissioning Agent shall witness all Startups of equipment required to be commissioned.
- J. Submit a report, PDF format preferred according to Section 013300 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.3 TESTING, ADJUSTING, AND BALANCING

- A. Owner will appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing.
- B. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or noncompliance with requirements of Contract Documents.

1.4 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.

4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 5. Identify and locate existing buried or concealed items encountered during Project.
 6. Measured depths of foundations in relation to finish floor datum.
 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 9. Field changes of dimension and detail.
 10. Details not on original Drawings.
 11. Provide photographs of congested areas before closed in by Gyp or finishes.
- G. Submit PDF electronic files of marked-up documents to Architect/Engineer before Substantial Completion.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.
- E. Installer's Inspection of Conditions
 1. Require Installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions.
 2. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- F. Contractor's Inspection. Inspect each item of material or equipment immediately prior to installation, and reject damaged and defective items.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
 - 1. Do not omit any preparatory step or installation procedure unless it is:
 - a. Verified with and accepted by Architect in writing.
 - b. Specifically modified or exempted by Contract Documents.
- C. Perform additional requirements that are specified which are greater than the manufacturer's requirements and do not have a deleterious effect on the product being installed.
- D. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- E. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Architect/Engineer for final decision.
- F. Allow for expansion of materials and building movement.
- G. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.

2. Coordinate enclosure of Work with required inspections, photographs and tests to minimize necessity of uncovering Work for those purposes.
- H. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
1. Refer questionable mounting heights choices to Architect/Engineer for final decision.
 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- I. Adjust operating products and equipment to ensure smooth and unhindered operation.
- J. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit request in advance of cutting or altering elements affecting:
1. Structural integrity of element.
 2. Integrity of weather-exposed or moisture-resistant elements.
 3. Efficiency, maintenance or safety of element.
 4. Visual qualities of sight-exposed elements.
 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching, including excavation and fill to complete Work and to:
1. Fit the several parts together, to integrate with other Work.
 2. Uncover Work to install or correct ill-timed Work.
 3. Remove and replace defective and nonconforming Work.
 4. Remove samples of installed Work for testing.
 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Structural Work: Conform to Structural requirements for cutting of structural members. Do no cutting of structural elements that could reduce structural load capacity, deflection ratio, or integrity of structural systems without prior direction from Structural Engineer.

- E. Plumbing, Heating, Ventilating and Air Conditioning, and Electrical Work: Refer to Division 22, Division 23, and Division 26.
- F. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- G. Cut masonry and concrete materials using masonry saw or core drill.
- H. Restore Work with new products according to requirements of Contract Documents.
- I. Fit Work tight to pipes, sleeves, ducts, conduits and other penetrations through surfaces.
- J. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- K. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- L. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.
- M. Leave areas clean and free from debris. Remove spillage, soiling, sealants and overspray from finished surfaces.

3.5 PROTECTING INSTALLED CONSTRUCTION

- A. In-Place Protection
 - 1. General
 - a. During handling and installation of work at project site, clean and protect work in progress and adjoining work on a basis of perpetual maintenance.
 - b. Clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period.
 - c. Adjust and lubricate moving components to ensure operability without damaging effects. Contractor is responsible for function, condition and unblemished appearance of all work on Project, and any item or work judged defective by Architect shall be subject to replacement at no additional cost to Owner.
- B. To extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous, damaging, or otherwise deleterious exposures during construction period.
- C. Protect installed Work and provide special protection where specified in individual Specification Sections.

- D. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- E. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- F. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective devices when no longer needed, prior to completion of work

3.6 SPECIAL PROCEDURES

- A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.
- B. Employ skilled and experienced installer to perform alteration work.
- C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces.
- F. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original condition.
- I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect for review.

- L. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Architect for review.
- M. Trim existing doors to clear new floor finish. Refinish trim to original condition.
- N. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- O. Finish surfaces as specified in individual product sections.

END OF SECTION 017005

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. General Requirement for Recycling and Adaptive Reuse.
2. Construction waste management plan.

B. Related Sections:

1.2 WASTE MANAGEMENT GOALS

- A. The Owner desires that this project generate the least amount of waste possible and that the Contractor employ processes to minimize the generation of waste due to error, poor planning, breakage, mishandling, contamination, or other factors.
- B. Of the waste material that is generated, as much as economically feasible shall be reused, salvaged, or recycled.
1. Recycle and/or salvage at least 50 % of the non-hazardous construction and demolition debris.

1.3 GENERAL REQUIREMENTS FOR RECYCLING

A. The General Contractor shall be responsible for:

1. Sorting, segregating, recycling, and placing designated waste materials into containers, and for disposing of all unacceptable and dangerous wastes as defined below.
2. Furnish waste and recycle collection containers, service those containers, and dispose of solid waste from the project, including unacceptable and dangerous waste.
3. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials clearly separated to eliminate co-mingling of unsuitable materials.

B. Waste which is disposed of by the General Contractor shall be in accordance with all applicable local, state and federal regulations, including WAC 173-350, Solid Waste Handling Standards, and WAC 173-303, Dangerous Waste Regulations.

1. Onsite recycling bins shall be well marked and easily distinguishable from waste bins. Each recycle bin shall be marked according to its contents.

1.4 PLAN REQUIREMENTS

- A. Develop and implement construction waste management plan as approved by Architect/Engineer.

B. Intent:

1. Divert construction, demolition, and land-clearing debris from landfill disposal.
2. Redirect recyclable material back to manufacturing process.
3. Generate cost savings or increase minimal additional cost to Project for waste disposal.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures contains requirements for submittals.
- B. Construction Waste Management Plan: Submit construction waste management plan describing methods and procedures for implementation and monitoring compliance including the following:
1. Transportation company hauling construction waste to waste processing facilities.
 2. Recycling and adaptive reuse processing facilities and waste type each facility will accept.
 3. Construction waste materials anticipated for recycling and adaptive reuse.
 4. On-Site sorting and Site storage methods.
- C. Submit documentation prior to Substantial Completion substantiating construction waste management plan was maintained and goals were achieved.
1. Trash: Quantity by weight deposited in landfills. Include associated fees, transportation costs, container rentals, and taxes for total cost of disposal.
 2. Salvaged Material: Quantity by weight with destination for each type of material salvaged for resale, recycling, or adaptive reuse. Include associated fees, transportation costs, container rentals, taxes for total cost of disposal, and reimbursements due to salvage resale.
 3. Total Cost: Indicate total cost or savings for implementation of construction waste management plan.

1.6 CONSTRUCTION WASTE MANAGEMENT PLAN

- A. Construction Waste Landfill Diversion: Minimum 50 percent by weight of construction waste materials for duration of Project through resale, recycling, or adaptive reuse.
- B. Implement construction waste management plan at start of construction.
- C. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.

- D. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.
- E. Dangerous Waste Management:
 - 1. Dangerous waste generated during the project shall be identified, accumulated and disposed in accordance with WAC 173-303. General Contractor generated dangerous waste must be shipped for disposal within 90 days of generation.
 - 2. General Contractor may accumulate dangerous waste in accordance with WAC 173-303 and Washington Department of Ecology Technical Information Memorandum 94-120, Satellite Accumulation (<http://www.ecy.wa.gov/pubs/94120.pdf>). If General Contractor accumulates dangerous waste in greater volume than 55 gal or acutely hazardous waste in greater volume than one quart, General Contractor shall establish and operate a “90-day” accumulation area in accordance with WAC 173-303.
 - 3. General Contractor shall dispose dangerous waste only through vendor(s) approved by owner. General Contractor shall arrange all dangerous waste shipments. Utilization of the vendor and facilities included in the State of Washington Hazardous Waste Disposal contract is authorized. Any other proposed vendor(s) and/or facilities are subject to audit by owner, prior to utilization. General Contractor shall pay for said audits.
- F. Purchase products to prevent waste by:
 - 1. Ensuring correct quantity of each material is delivered to Site.
 - 2. Choosing products with minimal or no packaging.
 - 3. Requiring suppliers to use returnable pallets or containers.
 - 4. Requiring suppliers to take or buy back rejected or unused items.
- G. Resources for Development of a Waste Management Plan: The following resource is available to assist in developing a waste management plan.
 - 1. <http://your.kingcounty.gov/solidwaste/greenbuilding/specifications-plans.asp>

1.7 CONSTRUCTION WASTE RECYCLING

- A. Use source separation method or comingling method suitable to sorting and processing method of selected recycling center. Dispose nonrecyclable trash separately into landfill.
- B. Source Separation Method: Recyclable materials separated from trash and sorted into separate bins or containers, identified by waste type, prior to transportation to recycling center.

- C. Comingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. 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.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Pre-bid meeting.
 - 2. Pre-construction meeting.
 - 3. Regular job-site meetings.

3.2 CONSTRUCTION WASTE COLLECTION

- A. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.
- B. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.
- C. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.
- D. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.3 CONSTRUCTION WASTE DISPOSAL

- A. Deliver construction waste to waste processing facilities. Obtain receipt for deliveries.
- B. Dispose of construction waste not capable of being recycled or adaptively reused by delivery to landfill, incinerator, or other legal disposal facility. Obtain receipt for deliveries.

3.4 SITE MAINTENANCE

- A. Do not use the Owner's waste containers for construction waste.
- B. Dispose daily of flammable, hazardous and toxic waste materials. Dispose of trash and debris in compliance with governing codes, ordinances, regulations and anti-pollution laws.
- C. Locate dumpster(s) at a site designated by the Owner.

END OF SECTION 017419

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Demonstration and instructions.
- C. Operation and maintenance data.
- D. Manual for equipment and systems.
- E. Spare parts and maintenance products.
- F. Product warranties and product bonds.
- G. Final cleaning.

1.2 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
 - 1. Submit maintenance manuals, Project record documents, digital images of construction photographs and other similar final record data in compliance with this Section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations and instructions to Owner's operating and maintenance personnel as specified in compliance Contract Documents.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
 - 5. Insurance: Advise Owner of insurance change-over requirements.
 - 6. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
 - 7. Make final change-over of locks and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.

8. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
9. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:

1. When Contractor considers Work to be substantially complete, submit to Architect/Engineer:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
2. Within seven days after receipt of request for Substantial Completion, Architect/Engineer will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Architect/Engineer determine that Work is not substantially complete:
 - a. Architect/Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Architect/Engineer.
 - c. Architect/Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Architect/Engineer's inspection.
4. When Architect/Engineer finds that Work is substantially complete, Architect/Engineer will:
 - a. Prepare Certificate of Substantial Completion on AIA G704 - Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Architect/Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
5. After Work is substantially complete, Contractor shall:
 - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.

6. Owner will occupy portions of building as specified in Section 011000 - Summary.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
1. When Contractor considers Work to be complete, submit certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 2. Submittals: Submit following:
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts and claims on AIA G706 - Contractor's Affidavit of Payment of Debts and Claims.
 - f. Contractor affidavit of release of liens on AIA G706A - Contractor's Affidavit of Release of Liens.
 - g. Consent of surety to final payment on AIA G707 - Consent of Surety to Final Payment Form.
 - h. Other Submittals Not Listed: Submit as required by State and Local agencies, Agreement, and Contracting Requirements.
 3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
1. Within seven days after receipt of request for final inspection, Architect/Engineer will make inspection to determine whether Work or designated portion is complete.
 2. Should Architect/Engineer consider Work to be incomplete or defective:

- a. Architect/Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
 - b. Contractor shall remedy stated deficiencies and send second written request to Architect/Engineer that Work is complete.
 - c. Architect/Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Architect/Engineer's inspection.
- E. Following determination that Work is complete, [Owner's Representative and] Architect will make recommendation to Owner for acceptance of Final Acceptance of Work.
- F. [Owner] Owner's Representative will issue Final Acceptance letter after determination that requirements for Final Completion have been fulfilled.
- G. Should [Owner's Representative and] Architect be required to perform more than two reviews for Substantial Completion or Final Completion, due to failure of the Work to conform to completion status claimed by Contractor:
1. Contractor will compensate [Owner's Representative and] Architect on a time and expense basis at customary hourly rate for each additional review.
 2. Compensation will be deducted from Contractor's Final Progress Payment.

1.3 DEMONSTRATION AND INSTRUCTIONS

- A. The Contractor must train Owner maintenance personnel in the operation and maintenance of mechanical and electrical equipment and other products identified in Contract Documents. Coordination must be maintained with systems designers for developing the hours of instruction and scope of material to be covered. Training of Owner personnel must not begin until the Architect has approved the final submittal copy of the Operation and Maintenance Manual.
- B. Demonstrate Project equipment instructed by qualified representative who is knowledgeable about the Project.
- C. Video Recordings: Provide high-quality color video recordings of demonstration and instructional sessions. Engage approved videographer to record sessions. Include classroom instructions, demonstrations, board diagrams, and other visual aids.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

- F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at designated location.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- H. Required instruction time for each item of equipment and system is specified in individual Specification Sections.
- I. At each training session, provide a sign-in sheet for signature of all Owner staff in attendance. Identify the sign-in sheet with the training being provided and the date of the training. Submit the sign-in sheet(s) before Final Acceptance.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit PDF copy of preliminary draft prior to Substantial Completion. Architect/Engineer will review draft and return one copy with comments. Revise content of document sets as required prior to final submission.
- B. Submit final copy in PDF composite electronic indexed file at Substantial Completion.
- C. Prepare media cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project.
- D. Internally subdivide media contents with permanent page dividers, logically organized as described below.
- E. Drawings: Provide scalable PDF copies in media requested.
- F. Contents: Prepare table of contents for media, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.

- f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - g. Safety precautions to be taken when operating and maintaining or working near equipment.
- 3. Part 3: Project documents and certificates, including the following:
 - a. Shop Drawings and product data.
 - 1) Air and water balance reports.
 - b. Certificates.
 - c. PDF copies of warranties and bonds. Deliver original to Owner in separate bound folder in CSI format.

1.5 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to place in location as directed by Owner; obtain receipt prior to final payment.

1.6 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed by responsible Subcontractors, suppliers and manufacturers within ten days after completion of applicable item of Work.
- B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information and are notarized.
- D. Co-execute submittals when required.
- E. Include table of contents and assemble in three D side ring binder with durable plastic cover. Maintain a PDF copy for O&M manual at project closeout.
- F. Submit prior to final Application for Payment.
- G. Warranties shall be dated for length of time specified from date of Substantial Completion and will be rejected if dated otherwise.
- H. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.

2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
 1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

3.2 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit final accounting statement to Architect making final adjustments to original Contract Sum.
- B. Indicate Original Contract Sum and determine Total Adjusted Contract Sum from additions and deductions resulting from previous Change Orders, Alternates, Unit prices, and other adjustments.
- C. Deduct previous payments from adjusted Contract Sum to determine Total Contract Sum remaining due.
- D. Architect will prepare final Change Order reflecting approved adjustments to Contract Sum not previously made by other Change Orders.

3.3 FINAL APPLICATION FOR PAYMENT

- A. Submit final Application for Payment in accordance with the Contracting Requirements, and procedures and requirements of Owner, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

END OF SECTION 017700

DIVISION 02
EXISTING CONDITIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition of designated construction and finishes
2. Cutting and alterations to accommodate new Work.
3. Disconnecting and capping designated utilities.
4. Salvaging designated items for reuse or Owner's retention.
5. Protection of items designated to remain.
6. Removal and disposal of demolished materials.

B. Related Sections:

1. Section 017419 - Construction Waste Management and Disposal.
2. Section 070150 - Maintenance of Roofing.
3. Section 033000 - Cast in Place Concrete.

1.2 SUBMITTALS

- A. Refer to Section 013300 - Submittal Procedures, for submittal requirements and procedures.
- B. Demolition Plan: Submit a Demolition Plan that generally describes the sequence of demolition work and a brief description of activities. Revise as necessary after review by A/E and Owner. Do not proceed until approved plan is received.
- C. Project Record Documents: Accurately record actual locations of capped utilities, surface obstructions and abandoned items. Submit this information with the project record documents (as-builts) per Section 017800.
- D. Shop Drawings:
 - 1. Phasing of demolition work.
 - 2. Indicate location and construction of barricades, fences, and temporary work.
- E. Existing Building Documentation: Submit a photographic survey indicating conditions before, during, and after demolition work.
- F. When existing conditions are discovered that differ from what is shown on the construction documents, a description and/or detailed drawings of the actual existing conditions need to be submitted to the Architect/Engineer immediately in a form that clearly shows the differences and locations. Approval will be required to continue work on these areas.

1.3 SITE CONDITIONS

- A. Maintenance of Services: Locate, protect, support, and maintain uninterrupted all utilities, equipment, services, and Owner's property within the limits of the Work.

1.4 QUALITY ASSURANCE

- A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Use trained, qualified workers for demolition work, dust control, electrical disconnection and re-connection, and removal of items to be salvaged.
- C. Conform to all State and local regulations for notification and handling procedures when hazardous or contaminated materials are discovered. Notify A/E and Owner and obtain direction to proceed.
- D. Perform Work in accordance with State and local ordinances.

1.5 LIFE SAFETY PROVISIONS

- A. No enclosure, shield or protective covering shall interfere with the use of an existing emergency exit at any time, unless a temporary exit is substituted and approved by the local Authority Having Jurisdiction (AHJ).
- B. Maintain fully charged, certified (inspected and approved), compliant fire extinguishers and hose racks, as required by the AHJ, readily available during demolition operations.
- C. Post "NO SMOKING" signs and enforce this precaution within the structure and within the AHJ required distance from the structure.
- D. Instruct demolition personnel in fire safety and fire drill policies appropriate for the areas where demolition operations occur.
- E. Deployment, disposition, administration and implementation of any and all safety measures are the sole responsibility of the Contractor.

1.6 SCHEDULING

- A. Section 013216 - Construction Progress Schedule.
- B. Schedule Work to precede new construction whenever possible.
- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation and activities in adjoining spaces.
- D. Perform noisy, malodorous, or dusty work:
 - 1. Between hours of 7:00 a.m. and 6:00 p.m.

2. On following days: Monday through Friday.
- E. Coordinate utility and building service interruptions with Owner.
 1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner and AHJ.
 2. Schedule tie-ins to existing systems to minimize disruption.
 3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

1.7 QUALIFICATIONS

- A. Demolition Firm: Company specializing in performing work of this section with minimum five years documented experience on projects of similar size, complexity and scope.

1.8 PRE-DEMOLITION MEETINGS

- A. Section 013119 - Project Meetings.
- B. Convene minimum one week prior to commencing work of this section.
- C. Review with Owner's Representative the Demolition Schedule. Discuss closures, shutdowns and operational impacts.

1.9 PROJECT CONDITIONS

- A. The Contractor is responsible for the safety of his workmen and shall follow all WISHA rules and regulations. The Contractor shall provide respirators when recommended or required.
- B. Conduct demolition to minimize interference with occupied building areas and adjacent buildings that are to remain in operation.
- C. Notify Architect/Engineer immediately if existing conditions differ from shown on construction documents.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing portions of work indicated to be demolished before demolition.
- B. Verify hazardous material abatement is complete before beginning demolition.

3.2 PREPARATION

- A. Call Local Utility Line Information service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Before beginning selective demolition activities: Provide, erect, and maintain temporary barriers, safety and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner and existing improvements indicated to remain. Erect temporary fences, overhead covers, temporary walkways, enclosed passageways, guard rails, chutes, etc. to protect personnel, construction, equipment and furnishings.
- C. Erect and maintain weatherproof closures for exterior openings.
- D. Protect existing items indicated to remain. Any collateral damage to or destruction of portions of the existing: structure, materials, equipment or systems shall be repaired and/or replaced by the Contractor at his expense.
- E. Provide appropriate temporary signage including signage for exit or building egress.

3.3 DEMOLITION REQUIREMENTS

- A. Remove all existing structure, materials, equipment and systems as necessary to obtain access for installation of new materials and systems scheduled or indicated on the drawings, whether specifically intended or not. Remove such existing ceilings, floors (flooring), walls, finish materials or equipment as required as part of the demolition work. Restore such surfaces, if indicated to remain, after demolition work is completed.
- B. Perform demolition in an orderly and careful manner. Protect existing supporting structural members and finishes.
- C. Disconnect and remove designated utilities within demolition areas.
- D. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.
- E. Concrete Demolition:
 - 1. Concrete flatwork shall be cut at its limits in a straight line full depth of the slab or wall with a saw. All concrete pieces shall be removed and disposed off site in a legal manner at an approved dumpsite.
- F. Holes required through existing stud walls, concrete or masonry construction, to accommodate new electrical conduits, shall be considered to be "cutting and patching" and shall be provided as specified in Section 017329 and Division 26 - Electrical.

- G. Holes required through concrete or masonry work, required for structural purposes, shall be neatly core drilled at sizes and location as approved by the A/E and in accordance with the details on the Drawings.
- H. Burning:
 - 1. The use of burning at the project site for the disposal of refuse and debris shall not be permitted. Remove demolished materials from the site except where specifically noted otherwise.
- I. Adjacent Structures and occupants:
 - 1. Conduct demolition to minimize interference with adjacent structures and occupancies.
 - 2. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures. Maintain protected egress and access from adjacent structures at all times.
- J. Use of Explosives:
 - 1. Use of explosives shall not be permitted.

3.4 OWNER HAS "FIRST RIGHT OF REFUSAL" OF ALL ITEMS.

- A. Owner reserves right to salvage items. Coordinate with Owner. Remaining unused demolition from building and site is Contractor's property. Remove from site and dispose of in legal manner.
- B. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner's local storage location.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged. Remove materials, to be reinstalled or retained, in a manner to prevent damage. Store and protect until reinstallation.
- E. Deliver salvaged items to Owner and obtain signed receipt.

3.5 CLEANING

- A. Continuous clean-up and remove demolished materials from site. Do not allow demolished materials not indicated to be salvaged or incorporated into the work to accumulate on the site.
- B. Refer to Section 017419 - Cleaning and Waste Management for segregation of materials and recycling requirements. Haul away all remaining materials and dispose of legally. Upon completion of Work, leave areas in clean condition.

3.6 SALVAGE SCHEDULE

- A. Owner reserves right to salvage items. Coordinate with Owner. Remaining unused demolition from building and site is Contractor's property. Remove from site and dispose of in legal manner.
- B. Protect the materials and equipment remaining:
 - 1. For the continued occupation for the rest of the Library throughout the duration of construction as indicated in 011000 - Summary.
 - 2. That are indicated for continued use in the construction of the renovation space.
 - 3. As indicated on drawings.
- C. Demolish the following materials and equipment:
 - 1. The items indicated on drawings.
 - 2. Unused items with no apparent purpose as approved by the Architect or Owner.
- D. List of salvaged items:
 - 1. Glass marker boards.
 - 2. Selected furniture.

END OF SECTION 024119

DIVISION 03

CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete reinforcement repair.
2. Concrete surface repair.
3. Concrete crack repair.

B. Related Sections:

1. Section 032000 - Concrete Reinforcing.
2. Section 033000 - Cast-In-Place Concrete.
3. Section 033500 - Concrete Curing and finishing.

1.2 REFERENCES

A. ASTM International:

1. ASTM A1064/A1064M - Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain-Steel Bars for Concrete Reinforcement.
3. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
4. ASTM C109/C109M - Standard Test Method for Compressive strength of Hydraulic Cement Mortars (Using 2 in. (50 mm) Cube Specimens).
5. ASTM C150/C150M - Standard Specification for Portland Cement.
6. ASTM C293/C293M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
7. ASTM C882/C882M - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
8. ASTM D570 - Standard Test Method for Water Absorption of Plastics
9. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
10. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
11. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

B. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
- C. Samples: Submit two color samples for patches exposed to view in finished construction and required to match existing.
- D. Manufacturer's Instructions: Submit mixing instructions.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- F. Sustainable Design Submittals:
 - 1. Sustainability Submittal Requirements: Refer to Section 018113 - Sustainable Project Requirements for submittals required by this Section to meet the sustainability goals for this Project.
- G. Closeout Submittals
 - 1. Section 017000 - Execution and Closeout Requirements: Closeout procedures.
 - 2. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.
 - 3. Operation and Maintenance Data: Procedures for submittals.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.
- B. Perform welding work in accordance with AWS D1.4.
- C. Qualifications
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - 2. Design reinforcement splices under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
 - 3. Applicator: Company specializing in concrete repair with minimum 3 years documented experience approved by manufacturer.

D. Mock-Up

1. Section 014000 - Quality Requirements: Requirements for mockup.
2. Construct mockup panel illustrating patching method, color and texture of repair surface.
3. Prepare one mockup of each type of injection and patching procedure.
4. Locate where directed by Architect/Engineer or indicated on Drawings.
5. Incorporate accepted mockup as part of Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Comply with instructions for storage, shelf life limitations and handling.

PART 2 PRODUCTS

2.1 EPOXY MATERIALS

- A. Acceptable Manufacturers:
 1. MBCC Group, Master Builders Solutions.
 2. Dayton Superior Corporation.
 3. The Euclid Chemical Company.
 4. Sika Construction Products.
 5. Laticrete L&M Construction Chemical.
 6. Simpson Strong Tie.
 7. Hilti.
 8. GCP Applied Technologies.
 9. Substitutions: Section 012500 - Substitution Procedures.
- B. Concrete Repair Epoxy Adhesive: Two-part epoxy adhesive containing 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces, meeting the following minimum characteristics:

Characteristic	Test Method	Results
Bond Strength	ASTM C882	2,500 psi
Tensile Strength	ASTM D638	4,400 psi

Elongation	ASTM D638	2 percent at 7 days 70 degrees F
Flexural Strength	ASTM D790	6,700 psi
Compressive Strength	ASTM D695	6,500 psi
Water Absorption	ASTM D570	2% maximum

- C. Concrete Repair Epoxy Bonding Resin: Two-part epoxy resin containing 100 percent solids, meeting the following minimum characteristics:
- D. Aggregate: Type recommended by mortar manufacturer.

2.2 CEMENTITIOUS MORTAR MATERIALS

- A. Acceptable Manufacturers:
 - 1. MBCC Group, Master Builders Solutions.
 - 2. Dayton Superior Corporation.
 - 3. The Euclid Chemical Company.
 - 4. Sika Construction Products.
 - 5. Laticrete L&M Construction Chemical.
 - 6. Simpson Strong Tie.
 - 7. GCP Applied Technologies.
 - 8. Hilti.
 - 9. Substitutions: Section 012500 - Substitution Procedures
- B. Cementitious Mortar: Packaged latex modified silica fume enhanced Portland cement patching mortar with the following properties:
 - 1. Compressive Strength: ASTM C109/C109M; minimum 2,000 psi (13.8 MPa) after one day and 4,000 psi (27.6 MPa) after 28 days.
 - 2. Bond Strength: ASTM C882; minimum 2,200 psi (15.2 MPa) after 28 days.
 - 3. Flexural Strength; ASTM C293; minimum 1,500 psi (10.3 MPa) after 28 days.
- C. Aggregate: Type recommended by mortar manufacturer.

2.3 RELATED MATERIALS

- A. Cast Underlayment: Refer to Section 035400.
- B. Bonding Agent: As recommended by topping product manufacturer.

- C. Bonding Agent for Concrete-to-Concrete: Refer to Section 033000 - Cast-in-Place Concrete.
- D. Refer to Section 033000 - Cast-in-Place Concrete for additional related materials.
- E. Portland Cement: ASTM C150.
- F. Sand: ASTM C33; uniformly graded, clean.
- G. Water: Clean and potable.
- H. Calcium Chloride: Not permitted.

2.4 REINFORCEMENT MATERIALS

- A. Refer to Section 032000 - Concrete Reinforcing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013100 - Project Management and Coordination.
- B. Verify surfaces are ready to receive work.
- C. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

- A. Clean concrete surfaces of dirt, laitance, corrosion, or other contamination; wire brush using cleaning agent recommended by product manufacturer rinse surface and allow to dry.
- B. Flush out cracks and voids with agent recommended by product manufacturer to remove laitance and dirt. Chemically neutralize by rinsing with water.
- C. For areas repaired using the injection method: Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than depth of crack to be filled or port size diameter no greater than thickness of crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.
- D. For areas patched with epoxy mortar: Remove broken and soft concrete as recommended by product manufacturer. Remove corrosion from steel. Clean surfaces mechanically; wash with agent recommended by product manufacturer; rinse with water.
- E. Sandblast clean exposed reinforcement steel surfaces. Mechanically cut away damaged portions of bar.

3.3 REPAIR WORK

- A. Repair reinforcement by welding new bar reinforcement to existing reinforcement with sleeve splices. Strength of welded splices and reinforcement to exceed original stress values.

- B. Repair exposed structural, shrinkage, and settlement cracks of concrete by epoxy injection, epoxy application or bonding agent and cementitious paste method.
- C. Repair spalling. Fill voids flush with surface. Apply surface finish.

3.4 MIXING EPOXY MORTAR

- A. Mix epoxy mortars to consistency for purpose intended, as recommended by the manufacturer.
- B. Mix components in clean equipment or containers. Conform to pot life and workability limits.

3.5 MIXING CEMENTITIOUS MORTAR

- A. Mix cementitious mortar to consistency required for purpose intended, as recommended by the manufacturer.
- B. Provide bonding agent as additive to mix as recommended by the mortar manufacturer. Use manufacturers approved bonding agent.

3.6 INJECTION - EPOXY RESIN

- A. Inject epoxy resin adhesive into prepared ports under pressure using equipment appropriate for particular application per manufacturer's written instructions.
- B. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.
- C. Remove temporary seal and excess adhesive.
- D. Clean surfaces adjacent to repair and blend finish.

3.7 APPLICATION - EPOXY MORTAR

- A. Apply product per manufacturer's written instructions.
- B. Trowel apply mortar mix to average thickness not to exceed mortar manufacturer's recommendations. Tamp into place filling voids at spalled areas.
- C. For patching honeycomb, trowel mortar onto surface, work mortar into honeycomb to bring surface flush with surrounding area. Finish trowel surface to match surrounding area.
- D. Cover exposed steel reinforcement with epoxy mortar, feather edges to flush surface.

3.8 APPLICATION - CEMENTITIOUS MORTAR

- A. Apply product per manufacturer's written instructions.

- B. Apply coating of bonding agent to concrete surfaces as recommended by manufacturer. Provide full surface coverage.
- C. Apply cementitious mortar by steel trowel to average thickness not to exceed mortar manufacturer's recommendations. Tamp into place filling voids at spalled areas. Work mix into honeycomb.
- D. Damp cure cementitious mortar as recommended by mortar manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

END OF SECTION 030100

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.
5. Waterstops.
6. Bolts and anchors.

B. Related Sections:

1. Section 030100 - Concrete Repair.
2. Section 032000 - Concrete Reinforcing.
3. Section 033000 - Cast-In-Place Concrete.
4. Section 033500 - Concrete Curing and Finishing.
5. Section 055000 - Metal Fabrications: Product requirements for metal fabrications for placement by this Section.
6. Section 076200 - Sheet Metal Flashing and Trim: Product requirements for flashing reglets for placement by this Section.
7. Division 22- Product requirements for mechanical items for placement by this Section.
8. Division 26- Product requirements for electrical items for placement by this Section.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

- B. American Forest and Paper Association:
 - 1. AF&PA - National Design Specifications for Wood Construction.
- C. The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- D. American Society of Mechanical Engineers:
 - 1. ASME A17.1 - Safety Code for Elevators and Escalators.
- E. ASTM International:
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 - 2. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product data for proprietary materials and items, including forming accessories, waterstops, and other as requested Architect.
- C. Submit ICC reports for each product where ICC approval is required.
- D. Delegated Design Submittals Data: Signed and sealed by professional engineer.
 - 1. Indicate design data for formwork, shoring, and re-shores.
 - 2. Indicate loads transferred to structure during process of concreting, shoring and reshoring.
 - 3. Include structural calculations to support design.
- E. Adhesive Anchor Installer certification by the ACI-CRSI Adhesive Anchor Installation Certification Program when installation by certified installer is required, refer to part 3 below.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301.

- B. For wood products furnished for work of this Section, comply with APA/EWA or AF&PA.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Products storage and handling requirements.
- B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.6 COORDINATION

- A. Section 01310 - Project Management and Coordination: Coordination and project conditions.
- B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.
- B. The materials to be provided are to meet the guidelines for selection as available and as part of the total package developed, as defined in Section 018113 - Sustainable Project Requirements.

2.2 FORM MATERIALS

- A. Form Materials for Unexposed Surfaces: At discretion of Contractor. Where waterproofing is required, surface roughness must be compatible with waterproofing manufacture's requirements.
- B. Form Material for Exposed Surfaces: Overlay Plywood.
 - 1. Forms: Conform to PS 1; AC or BB high density overlaid concrete form, Class 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
 - 2. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8 inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.
 - 3. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4 inch thick.

- C. Forms for Cylindrical Columns and Supports: Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Columns exposed to view to have smooth surface, (no barber pole).
- D. Material for formwork and shoring which is to be left in place: Non-organic material only. At the discretion of the Architect. Void cannot be filled.

2.3 PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.
- C. Pan Type: Steel or Glass fiber of size and profile required.
- D. Tubular Column Type: Round, surface treated with release agent, non-reusable, sizes as indicated on Drawings Metal, fiberglass reinforced plastic, or paper or fiber tubes. Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Columns exposed to view to have smooth surface, (no barber pole).
- E. Steel Forms: Sheet steel, suitably reinforced and designed for particular use indicated on Drawings.
 - 1. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.4 FORMWORK ACCESSORIES

- A. Form Ties:
 - 1. Not Exposed Condition: Carbon steel wire snap-off type, adjustable length, 1" x 1" plastic cone type, 1" break back dimension, free of defects that could leave holes larger than 1 1/4" in concrete surface.
- B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch (25 mm) of concrete face. Wire ties, wood spreaders or through bolts are not permitted.
- C. Form Anchors and Hangers:
 - 1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.

2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
3. Penetration of structural steel members is not permitted.
- D. Form Release Agent: Compound that will not stain concrete, or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete. Meets maximum VOC content of 100 g/L for Form Release Compounds as required by the SCAQMD 1113.
- E. Corners: Chamfer, 3/4 inch x 3/4 inch (19 mm x 19 mm) unless noted otherwise; maximum possible lengths.
- F. Flashing Reglets: Galvanized steel, 22 gauge thick, longest possible lengths, with alignment splines for joints, release tape sealed slots, anchors for securing to concrete formwork. Surface applied reglets are not allowed.
 1. Acceptable Manufacturers:
 - a. Fry Reglet "CO" concrete reglet, 26 gauge galvanized steel.
 - b. Substitutions: Section 012500 - Substitution Procedures.
- G. Vapor Retarder: Refer to Section 072600.
- H. Bituminous Joint Filler: ASTM D1751.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.
- J. Keyways shall be formed using wood or removable plastic or metal preformed units to sizes indicated.

2.5 CONCRETE ACCESSORIES

- A. Waterstops:
 1. Type 1: Self expanding waterstop embedded in concrete and spanning control, expansion, and/or construction joints with sealant recommended by waterstop manufacturer.
 - a. Acceptable Manufacturers:
 - 1) Sika Greenstreak; Hydrotite CJ.
 - 2) GCP Applied Technologies; Adcor ES.
 - 3) Substitutions under provisions of Section 012500 - Substitution Procedures.

2. Type 2: Self expanding waterstop used in non moving joints with sealant recommended by waterstop manufacturer.
 - a. Acceptable Manufacturers:
 - 1) Sika Greenstreak Swellstop.
 - 2) Cetco; Waterstop - RX.
 - 3) Substitutions under provisions of Section 012500 - Substitution Procedures.
- B. Grout Anchor Sleeves: Galvanized P.T. duct with .05 inch wall thickness to sizes indicated.
- C. Bearing Pads: Reinforced rubber elastomer pad per:
 1. Acceptable Manufacturers:
 - a. JVI, Inc.; Masticord
 - b. Fabreeka Product Co.; Fabreeka Bearings
 - c. Substitutions under provisions of Section 012500 - Substitution Procedures.
- D. Sliding Bearing Pads: Assembly consisting of upper and lower sliding element of PTFE bonded to steel plates. Lower element to be bonded to reinforced rubber elastomer pad.
 1. Acceptable Manufacturers:
 - a. JVI, Inc.; Dynalon.
 - b. Fabreeka Product Co.; Fabreeka Bearings
 - c. Substitutions under provisions of Section 012500 - Substitution Procedures.
- E. Adhesive Anchor: Two-part, self-mixing, cartridge type epoxy adhesive for anchoring thread rebar and all thread rod.
 1. Acceptable Manufacturers:
 - a. Simpson Strong Tie; "SET-XP Epoxy"
 - b. DeWalt, "Pure110+"
 - c. Redhead; "C6+"
 - d. Hilti; "Hit-RE 500-V3" or "Hit HY-200V3"
 - e. Use subject to approval by ICC

- f. For applications in temperatures below what is set by the Manufacturer use Cold Weather Adhesive Anchor per manufacturers requirements.
 - g. Substitutions under provisions of Section 012500 - Substitution Procedures.
- F. Cold Weather Adhesive Anchor
 - 1. Acceptable Manufacturers:
 - a. Hilti; Hit-Ice.
 - b. Simpson; "AT-XP"
 - c. DeWalt; AC100+Gold (CMU)
 - d. DeWalt "AC200+"
 - e. Use subject to approval by ICC
 - f. Substitutions under provisions of Section 012500 - Substitution Procedures.
- G. Expansion Bolts:
 - 1. Acceptable Manufacturers:
 - a. Simpson Strong Tie Co.; Strong-Bolt 2
 - b. DeWalt - Power-Stud + SD2
 - c. Hilti; Kwik Bolts T-Z2.
 - d. Use subject to approval by ICC
 - e. Substitutions under provisions of Section 012500 - Substitution Procedures.
- H. Screw Anchors (1 piece carbon steel threaded bolt for concrete):
 - 1. Acceptable Manufacturers:
 - a. Simpson Strong Tie-Co.; Titen HD.
 - b. DeWalt Screw Bolt+.
 - c. DeWalt, Snake+.
 - d. Hilti, Inc.; KH-EZ.
 - e. Substitutions under provisions of Section 012500 - Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 013100 - Project Management and Coordination. Ensure that dimensions agree with drawings.
- B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.
- C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

3.2 INSTALLATION

- A. Earth Forms:
 - 1. Earth forms are permitted at bottom of sloped footings at change of level only and only if soil on sides is firm.
 - 2. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.
 - 3. Verify locations with Structural Engineer and Geotechnical Engineer.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Do not reuse formwork that will perform less well than new. Do not patch formwork.
- D. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- E. Align joints and make watertight. Keep form joints to a minimum.
- F. Obtain approval from Architect before framing openings in structural members which are not indicated on Drawings.
- G. Provide chamfer strips on external corners of all exposed to view concrete.
- H. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- I. Formwork - General:
 - 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 - 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.

3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
 4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
 5. Complete wedging and bracing before placing concrete.
- J. Forms for Smooth Finish Concrete:
1. Use steel, plywood or lined board forms.
 2. Use clean and smooth plywood and form liners, uniform in size and free from surface and edge damage capable of affecting resulting concrete finish.
 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
 4. Use full size sheets of form lines and plywood wherever possible.
 5. Tape joints to prevent protrusions in concrete.
 6. Use care in forming and stripping wood forms to protect corners and edges.
 7. Level and continue horizontal joints.
 8. Keep wood forms wet until stripped.
- K. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.
- L. Framing, Studding and Bracing:
1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
 2. Distribute bracing loads over base area on which bracing is erected.
 3. When placed on ground, protect against undermining, settlement or accidental impact.
- M. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- N. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

3.3 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices and embedded items.

- C. Do not apply form release agent to formwork which is to be left in place or where concrete surfaces are indicated to receive special finishes or applied coverings that could be affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.
- D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - ACCESSORIES, INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Provide formed openings where required for items to be embedded in or passing through concrete work. Provide temporary access pockets for vibrating concrete at wide opening sills.
- B. Locate and set in place items required to be cast directly into concrete. Use templates to hold anchor rods in place during concrete placement.
- C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, other inserts and components of other Work.
- D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Install waterstops continuous per manufacturer's requirements and as shown without displacing reinforcement. Seal joints watertight to waterstop manufacturer's recommendations.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- H. Form Ties:
 - 1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
 - 2. Place ties at least 1 inch (25 mm) away from finished surface of concrete unless noted otherwise.
 - 3. Leave inner rods in concrete when forms are stripped.
 - 4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

5. When architecturally exposed ties are used, assure the pattern and style are as detailed on the drawings.
- I. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
 3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
 4. Arrange joints in continuous line straight, true and sharp.
- J. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete. Obtain installation and setting information for embedded items furnished under other Specification sections.
 3. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 4. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.
- K. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
 2. Slope slabs to drain where required or as shown on Drawings.
 3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.
- L. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which shall not puncture the membrane.
 2. Staking through membrane is not permitted.
- M. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.

2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.
- N. Install dowels, rebar, threaded or smooth steel dowels and all thread rebar, size and spacing to match reinforcing in adhesive anchor per manufacturers requirements, and as shown on drawings. Holes must be blown out with air gun or vacuumed out per manufacturer's requirements. Special inspection is required. Refer to general notes and special inspection drawing. See section 032000.
- O. Adhesive anchors shall be installed by an Adhesive Anchor Installer certified by the ACI-CRSI Adhesive Anchor Installation Certification Program where installed in a horizontal or upwardly inclined position and where indicated in the plans as an "adhesive tension anchor."
- P. Unless indicated, separate slabs on grade from vertical surfaces with 3/8 inch thick, joint filler indicated in Section 033000. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface. Use joint sealer 3/8" wide by 1/4" deep to seal joint. Refer to Section 079200.
- Q. Install joint devices in accordance with manufacturer's instructions. See section 033000.
- R. Install joint covers in one piece longest practical length, when adjacent construction activity is complete.
- S. Floor control joint device (e.g. zip strip) or Speed-E-Joint by W.R. Meadows, used as a floor crack inducer shall be used only in areas covered by finished flooring materials and shall not be used in areas either indoor or outdoor where exposed to view. See section 033000.
- T. Install bearing pads per manufacturer's recommendations. Where steel plates are welded to imbeds, use the smallest diameter weld rod to minimize heat build-up so that PTFE bond will not be subject to more than 300°F. Refer to Section 055000.
- U. Install epoxy coated dowels where indicated on drawings. See Section 032000.

3.5 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
- C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and after flatness/levelness has been approved.
- B. Loosen forms carefully. Do not wedge pry bars, hammers or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.
- D. Under ordinary conditions, formwork and supports shall remain in place for not less than the periods of time under schedule - Form Removal. These periods represent cumulative number of days or hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above 50°F. If high-early-strength concrete is used, these periods may be reduced as approved by the Architect. Conversely, if ambient temperatures remain below 50°F or if retarding agents are used, then these periods shall be increased at the discretion of the Architect.
- E. Forms and shoring in the formwork used to support the weight of concrete in beams, slabs and other structural members shall remain in place until the formwork for the supported member is allowed to be removed.
- F. Before shore removal the strength to be attained by members carrying their own dead load shall be no less than 75% of the specified strength, f_c . Furthermore the contractor shall restrict construction live loading to 50% of the design live load.

3.7 CONCRETE CURING AND FINISHING

- A. Cure concrete floors as specified in Section 033500 - Concrete Curing and Finishing.
- B. For general concrete curing refer to ACI 308.1.

3.8 ERECTION TOLERANCES

- A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117, except as otherwise indicated.
- B. Construct and align formwork for elevator hoistway(s) in accordance with ASME A17.1.
- C. Camber slabs and beams as indicated on drawings.

3.9 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting and balancing.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- C. Notify Architect/Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

- D. Schedule concrete placement to permit formwork inspection before placing concrete.

3.10 SCHEDULES - FORM REMOVAL

- A. The following times represent a cumulative amount of time during which the temperature of the air surrounding the concrete is above 50° F;
1. Walls and column encasement: 12 hours.
 2. Columns: 12 hours.
 3. Sides of beams: 12 hours.
 4. Beam soffits: Under 10 feet clear span between structural supports: 7 days.
 5. Beam soffits: Over 10 feet clear span between structural supports: 14 days.
 6. Precast floor panel infill: 4 days.

3.11 SCHEDULE - TESTING BY OWNER-FURNISHED TESTING LAB

- A. Refer to Special Inspecting and Testing on Structural Drawings

3.12 SCHEDULES

- A. Provide concrete as indicated and detailed on drawings.

END OF SECTION 031000

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

B. Related Sections:

1. Section 030100 - Concrete Repair.
2. Section 031000 - Concrete Forming and Accessories.
3. Section 033000 - Cast-In-Place Concrete.
4. Section 033500 - Concrete Curing and Finishing
5. Division 26 - Grounding and Bonding for Electrical Systems: Grounding concrete reinforcement.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 530.1 - Specifications for Masonry Structures.
4. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:

1. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
2. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
3. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
4. ASTM A780/A780M Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

5. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- C. American Welding Society:
 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute:
 1. CRSI - Manual of Standard Practice.
 2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings:
 1. Indicate bar sizes, spacing, locations, and quantities of reinforcing steel [and welded wire fabric,] bending and cutting schedules and supporting and spacing devices for reinforcement and accessories in 1/4 inch minimum scale elevations and plans.
 2. General Contractor and Subcontractor to review shop drawings and add all proposed openings to drawings before submitting to Architect.
- C. Certificates: Submit AWS qualification certificate for welders employed on the Work.
- D. Submit ICC reports for each product where ICC approval is required.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- F. Submit request to use splices not shown on the project drawings.
- G. Submit request to use mechanical splices not shown on the project drawings.
- H. Submit request for placement of column dowels without the use of templates.
- I. Submit request and procedure to field bend or straighten partially embedded reinforcement.
- J. Submit description of reinforcement weld locations, weld procedures, and welder qualifications.
- K. Submit proposed supports for coated reinforcement and uncoated reinforcement when it is necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items. Provide a submittal showing the resulting arrangement of reinforcement.
- L. Submit request to heat and bend reinforcement when required.
- M. Submit certified copies of mill test report of reinforcement materials analysis.

N. Sustainable Design Submittals:

1. Sustainability Submittal Requirements: Refer to Section 018113 - Sustainable Project Requirements for submittals required by this Section to meet the sustainability goals for this Project.
2. Embodied Carbon Submittals:
 - a. Life-cycle assessment conforming to ISO 14044; Product -specific Type III EPD Internally Reviewed or Facility Specific.
 - 1) Environmental Product Declarations for concrete reinforcing.
3. Sourcing of Raw Materials - Recycled Content Submittals:
 - a. Indicate recycled content of concrete reinforcing; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

- A. Deliver, store, protect and handle products to site under provisions of Section 016000 - Product Requirements.
- B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with CRSI - Manual of Standard Practice and ACI 301.
- B. Prepare shop drawings in accordance with ACI SP-66.

1.6 QUALIFICATIONS

- A. Welders: AWS qualified within previous 6 months.

1.7 COORDINATION

- A. Section 013100 - Project Management and Coordination and project conditions.
- B. Coordinate with placement of formwork, formed openings and other Work.
- C. All trades with openings in concrete or masonry are to show size and location of proposed openings on shop drawings before submitting drawings to Architect for approval.
- D. Location of reinforcement takes precedence over that of work by other trades.

PART 2 PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

- A. Section 018113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
 - 1. Embodied Carbon - Concrete Reinforcing
 - a. Provide a Type III Product-Specific or Facility Specific Environmental Product Declaration (EPD) that documents compliance with the following:
 - 1) Embodied Carbon Limit: 630 kg CO₂e.
 - 2) System Boundary Product Stage: A1-A3.
 - 3) Declared Unit: Fabricated cubic meter.
 - 4) Product Category Rules:
 - (a) North American Product Category Rule for Designated Steel Construction Products, dated April 29, 2015.
 - 2. Responsible Sourcing of Raw materials - Concrete Reinforcing
 - a. Source concrete reinforcing domestically.
 - b. Recycled content: Minimum 67% post-consumer recycled content.

2.2 REINFORCEMENT

- A. Reinforcing Steel: As noted on the Structural Drawings.
- B. Deformed Reinforcement: ASTM A615, 60 ksi yield grade, steel bars, unfinished.
- C. Deformed and Plain Reinforcement: ASTM A706; 60 ksi yield strength, steel bars, unfinished where weldable rebar is required. Other grades as noted on drawings.
- D. Plain Wire: ASTM A1064/A1064M; galvanized finish.
- E. Welded Deformed Wire Fabric: ASTM A1064/A1064M; in flat sheets; unfinished.
- F. Welded Plain Wire Fabric: ASTM A1064/A1064M; in flat sheets; unfinished.
- G. All Thread Rebar: "Williams" Grade 75 meets or exceeds physical properties of ASTM A615.
- H. Epoxy Coating: As noted on the Structural Drawings conforming to applicable ASTM Standard.

2.3 ACCESSORY MATERIALS

- A. Tie Wire: As noted on the Structural Drawings, or patented system as approved.

- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions, including CRSI "SBU" Type chairs or load bearing pads on bottom to prevent vapor retarder puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel, Plastic tipped steel or Stainless steel type; size and shape and spacing to maintain bars in required position.
- D. Precast concrete block chairs to be made from 4000 psi concrete and have (2) 16 gauge tie wires cast in center.
- E. Flanged Rebar Couplers (FRC): Williams Form Engineering Corp. C2D rebar flange coupler, Dayton-Superior D340 Taper Lock Flange Coupler, or approved equivalent. Provide in size to meet or exceed rebar capacity. System may be used as substitutions for dowel bars.
- F. All Thread Rebar Couplers: Williams Form Engineering., Portland, OR (503) 285-4548.
- G. Ferrule Loop Insert - "F-42" by Dayton Superior, size as indicated. Substitutions per specification Section 012500 - Substitution Procedures.
- H. Bar Couplers: Provide ICC or IAPMO report.
 - 1. HRC Xtender 500/510 Position Couplers.
 - 2. Dayton Superior Bar Lock Couplers System.
 - 3. Sizes as required.
 - 4. Substitutions per specification section 012500 - Substitution Procedures.
- I. Expansion Bolts: Refer to Section 031000 - Concrete Forming and Accessories.
- J. Adhesive Anchors: Refer to Section 031000 - Concrete Forming and Accessories.
- K. Screw Anchors: Refer to Section 031000 - Concrete Forming and Accessories.
- L. Provide templates for placing column, footing anchor rods.
- M. Welding electrodes of type complying with AWS Code as required for welding ASTM A706, grade 60 steel as applicable.
- N. Threaded Dowels: Fabricate from ASTM A615 Grade 60 reinforcement steel threaded to fit expansion anchor furnished. Dowel to be one diameter size larger than continuous reinforcement size shown.

2.4 FABRICATION

- A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice and ACI 318.

- B. Form standard hooks for: 180 degree bends, 90 degree bend, stirrup and tie hooks, and seismic hooks as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters in accordance with ACI 318.
- D. Weld reinforcement in accordance with AWS D1.4.
- E. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Engineer.

2.5 SHOP FINISHING

- A. Galvanized Finish for Steel Bars: ASTM A767/A767M, Class I, hot dip galvanized after fabrication.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Refer to applicable Division 3 and 4 sections.
- B. Place, support and secure reinforcement against displacement. Provide carrier bars as required to maintain position of bars. Do not deviate from required position beyond specified tolerance.
 - 1. Do not weld crossing reinforcement bars for assembly.
- C. Do not displace or damage vapor retarder.
- D. Accommodate placement of formed openings.
- E. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.
 - 1. Where bars are indicated in multiple layers, place upper bars directly above lower bars, unless noted otherwise.
- F. Maintain concrete cover around reinforcement in accordance with ACI 318 and as noted on the drawings.
- G. Call for special inspection. Concrete is not to be ordered for delivery until after formwork and reinforcement has been approved by the Special Inspector.
- H. Splice reinforcing where indicated on Drawings in accordance with splicing device manufacturer's instructions.
- I. Epoxy coated bars that are field bent or damaged in the field shall be touched up with 2 brush coats of epoxy paint.
- J. Galvanized rebar that are field bent, welded, or damaged in the field shall be touched up with 2 brush coats of organic, zinc rich paint, passing ASTM A780.

- K. Bond and ground reinforcement in accordance with requirements of Division 26.

3.2 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Install reinforcement within the tolerances specified in ACI 301.

3.3 FIELD QUALITY CONTROL

- A. Refer to applicable Divisions 03 and 04 sections.
- B. Section 014000 - Quality Requirements and 017000 - Execution: Field inspecting, testing, adjusting and balancing.
- C. Field inspection and testing will be performed by Testing Laboratory and Inspector employed by the Owner in accordance with applicable code.
- D. Provide free access to Work and cooperate with appointed firm. See drawings S-011 & S-012.
- E. Reinforcement Inspection: See drawings S-011 & S-012.

END OF SECTION 032000

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foundation walls.
2. Mud slabs.
3. Slabs on grade.
4. Joint devices: Control, expansion and contraction.
5. Equipment pads.
6. Concrete Mix/Materials.
7. Admixtures.
8. Controlled Low Strength Material (CLSM, CDF and lean concrete)

B. Related Sections:

1. Section 030100 - Concrete Repair.
2. Section 031000 - Concrete Forming and Accessories.
3. Section 032000 - Concrete Reinforcing.
4. Section 033500 - Concrete Curing and Finishing.
5. Section 055000 - Metal Fabrications: Supply of metal fabrications for placement by this Section.
6. Section 076200 - Sheet Metal Flashing and Trim: Supply of flashing reglets for placement by this Section.
7. Section 079200 - Joint Sealants.
8. Section 079500 - Expansion Control.
9. Division 22 - Mechanical items for casting into concrete.
10. Division 26 - Electrical items for casting into concrete.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 305.1 - Specification for Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Standard Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM B221/B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

17. ASTM C685/C685M - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
19. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
20. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
21. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
22. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
23. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
24. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
25. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
26. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
27. ASTM C1218/C1218M - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
28. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
29. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
30. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
31. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
32. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
33. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

34. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
 35. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 36. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. California Department of Health Services:
1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- D. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - January 7, 2005 - Adhesive and Sealant Applications.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Product Data for proprietary materials and items including admixtures, joint systems, finishing materials, and other as requested by Architect.
- D. Design Data: Prior to placing any concrete and within 20 days of award of contract, submit for Architect's review the following per Structural General Notes - Deferred Submittals;
 1. Submit to Architect and inspecting and testing firm for review prior to commencement of work, identifying each class of concrete with letters corresponding to those indicated in the Concrete Mix Design Table in the Structural General Notes.
Minimum acceptable evidence shall be laboratory trial mix data or field test data (30 or more tests or mixes, identical to proposed mix, made during the past 12 months) with the appropriate standard deviation analysis, all in accordance with ACI 301
 2. Identify mix ingredients and proportions, including admixtures.
- E. Materials certificates shall be signed by manufacturers and contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- F. Submit control joint and pour stop layout to Engineer ten (10) days prior to installation.
- G. Prior to placement in 95 degree Fahrenheit or warmer weather, for concrete exposed to view; submit a thermal control plan.

H. Sustainable Design Submittals

1. Refer to Section 018113 - Sustainable Project Requirements for submittals required by this Section to meet the sustainability goals for this Project.
2. Embodied Carbon Submittals:
 - a. Environmental Product Declarations: Submit product-specific Environmental Product Declarations (EPDs) for each product (mix design) proposed on the project.
 - 1) Life-cycle assessment conforming to ISO 14044; Product-specific Type III EPD-Internally Reviewed - Products with 3rd party certification or EPD which conforms to ISO 14025 and EN 15804 or ISO 21930.
 - 2) Provide compliant embodied carbon optimization report or action plan separate from LCA or EPD.

I. Closeout Submittals

1. Section 017700 - Closeout Procedures: Closeout procedures.
2. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301. Maintain one copy of ACI 301 on site.
- B. Conform to ACI 305.1 when concreting during hot weather.
- C. Conform to ACI 306.1 when concreting during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Pre-Installation Meeting:
 1. Section 013119 - Project Meetings.
 2. Convene minimum one week prior to commencing work of this section. Parties in attendance to be General Contractor, Owners Representative, Architect, Flooring Installer, Mechanical Engineer, Electrical Engineer, Structural Engineer, Independent Inspector, Concrete Foreman, Concrete Supplier, Pumping Contractor, and Concrete Finisher. Agenda to include coordinating embed items and openings, mix design and additives, testing and inspection, form tolerances and stripping, curing methods, finishes and control joint locations.
- F. Mock up
 1. Section 014000 - Quality Requirements: Requirements for mockup.

2. Mockup Panel: Sufficient size to indicate special treatment or finish required.
3. Locate where directed by Architect/Engineer.
4. Incorporate accepted mockup as part of Work.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements.
- B. Maintain concrete temperature after installation per ACI 301.

1.6 COORDINATION

- A. Section 013000 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Vapor Retarder Permeance: Refer to Section 072600 - Vapor Retarders.
- B. Sustainability Characteristics
 1. Section 018113 - Sustainable Design Requirements: Requirements for sustainable design compliance.
 - a. Meet CDPH Standard Method emissions criteria.
 - b. Comply with South Coast Air Quality Management District (SCAQMD) Rule 1168, effective February 7, 2017.
 - c. Methylene chloride and perchloroethylene may not be intentionally added.
 - d. Embodied Carbon - Concrete Mix Design
 - 1) Provide a Type III Product Specific of Facility Specific Environmental Product Declaration (EPD) that documents compliance with the following:
 - (a) Embodied Carbon Limit:
 - (1) 3000 psi - 175 kgCO₂e per cubic yard or 230 kgCO₂e per cubic meter
 - (2) 4000 psi - 215 kgCO₂e per cubic yard or 280 kgCO₂e per cubic meter

(3) 5000 psi - 260 kgCO₂e per cubic yard or 340 kgCO₂e per cubic meter

(4) 6000 psi - 275 kgCO₂e per cubic yard or 365 kgCO₂e per cubic meter

(b) System Boundary: Product Stage A1-A3.

(c) Declared Unit: Produced cubic yard or cubic meter.

(d) Product Category Rules: ISO 21930:2017.

2.2 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Portland type. Type II - Moderate Portland type.
- B. Blended Cement: ASTM C595; Blended cements are permitted to be used in lieu of ASTM C150 cement if all requirements for fly ash, slag, pozzolans and cement are met. Color to be selected.
- C. Fine and Coarse Aggregates: ASTM C33. No iron aggregates allowed in concrete.
- D. Water: Comply with ASTM C1602.
- E. Fly Ash: ASTM C618, Class F.
- F. Slag for Cement: ASTM C989.
- G. Controlled Density Fill (CDF, CLSM and lean concrete): Designed and proportioned specifically for this project, obtained by a predetermined combination of water-reducing/set controlling/ plastic flow producing admixtures conforming to ASTM C494 types A through G as an Admixture System.

2.3 ADMIXTURES

- A. Acceptable Manufacturers:
 - 1. Master Builders Solutions.
 - 2. Euclid.
 - 3. GCP Applied Technologies.
 - 4. Sika.
 - 5. Substitutions: Section 012500 - Substitution Procedures.
- B. All admixtures shall be from the same manufacturer to ensure compatibility.
- C. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05% chloride ions are not permitted.

- D. Shrinkage-Reducing Admixture: Conforming to ASTM C494, Type S.
- E. Air Entrainment: ASTM C260. Certified by manufacturer to be compatible with other admixtures.
- F. Water Reducing Admixture: Conforming to ASTM C494, Type A shall contain no chlorides (not more than 0.05 percent). The amount of admixture added to the concrete shall be in accordance with the manufacturer's recommendations to obtain between 5% and 10% water reduction.
- G. Water Reducing, Retarding Admixture: Conforming to ASTM C494, Type D and not containing more chloride ions than are present in municipal drinking water.
- H. High Range Water Reducing Admixture (Superplasticizer): Conforming to ASTM C494 type F or G. The admixture shall be free of chlorides and alkalis. Use a third generation superplasticizer which shall be job site added in measured container, extended plastic-flow time, maintain setting characteristics similar to normal concrete throughout its recommended dosage range at varying concrete temperatures, reduce water 30 to 40 percent, give high early and ultimate strengths.
- I. Non-Corrosive, Non-Chloride Accelerator: Conforming to ASTM C494, Type C or E shall be non-chloride and shall not promote corrosion of reinforcing steel in concrete.
- J. Corrosion Inhibitor: Calcium nitrite (if called for on the drawings). Per manufacturers' recommendation, to be added to specified concrete.
- K. Microsilica (Silica Fume) Admixture Conforming to ASTM C1240: Dry densified or slurry formed. Microsilica shall come from the same source throughout the project. If a single source cannot be maintained, laboratory testing of each new source shall be required before acceptance by the Engineer at no cost to the Owner.
- L. Polyfiber Reinforcement
 - 1. Acceptable Manufacturers:
 - a. Fibermesh, Sika.
 - b. Forta Concrete Fiber.
 - c. Euclid Concrete Fibers.
 - d. GCP Applied Technologies.
 - e. Substitutions under provisions of Section 012500.

2. Polyfiber Reinforcement (Micro): Conforming to ASTM C1116. Fibers of collated fibrillated polypropylene containing no pre-processed Olefin materials to reduce plastic and hardened concrete shrinkage, improve impact strength, increase fatigue resistance and for secondary reinforcing of concrete slabs and members. Medium-duty fiber to increase bonding power, long-term concrete durability, and secondary/temperature control. Nylon fibers not allowed. The product shall have a UL rating. Apply at rate recommended by manufacturer to achieve optimal performance.
3. Polyfiber Reinforcement (Macro): Fibers of collated fibrillated polypropylene/polyethylene or a blend of cold drawn steel wire fiber and 100% polypropylene fibers containing no pre-processed Olefin materials to reduce plastic and hardened concrete shrinkage, improve impact strength, increase fatigue resistance and for secondary reinforcing of concrete slabs and members. Heavy-duty fiber to increase bonding power, long-term concrete durability, and secondary/temperature control. Nylon fibers not allowed. The product shall have a UL rating. ASTM C1116, minimum of 2 inches long, and aspect ratio of 50 to 90. Fiber manufacturer shall provide data to satisfy engineering requirements. Fiber manufacturer shall provide 2 hour fire resistance certification from UL when used in lieu of WWF in composite metal decks. Macro fibers shall be used and dosed in strict accordance with the manufacturer's maximum recommendations unless noted otherwise on the drawings. Apply at rate recommended by manufacturer to achieve optimal performance.
4. Admixtures not listed above are to be approved by Engineer on Record before use. Including, but not limited to; pigments, pumping aids, and anti-freeze.

2.4 ACCESSORIES

- A. Bonding Agent for Concrete to Concrete:
 1. W.R. Meadows: Intralok or Acry-lok Bonding Agent.
 2. Euclid Chemical Co. Product: SBR Latex.
 3. Master Builders Solutions.
 4. Larsen Product Co.: Weldcrete.
 5. L&M Construction Materials Product: Everbond.
 6. GCP Applied Technologies: Daraweld.
 7. Substitutions: Under provision of Section 012500 - Substitution Procedures.
- B. Vapor Retarder: Refer to Section 072600 - Vapor Retarders.
- C. Non-Shrink Grout: Refer to Section 036000 - Grouting.

D. Metal stair nosings and abrasive strips: Refer to Section 055000 - Metal Fabrications.

E. Additional concrete accessories refer to Section 031000 - Concrete Reinforcing.

2.5 JOINT DEVICES AND FILLER MATERIALS

A. Section 079200 - Joint Sealants: Joint Sealants for use at expansion joint and isolation joints.

B. Section 030100 - Concrete Repair: For cracks over 1/2 inch.

C. Recessed Preformed Joint Fillers:

1. Asphalt Impregnated Joint Filler: Conforming to ASTM D1751. W.R. Meadows, Fibre Expansion Joint No. 320-F, specified for type and quality.
2. Rigid Foam Joint Fillers: W.R. Meadows Deck-O-Foam with removable pre-scored strip for installation of elastomeric joint sealants and backer rods, specified for type and quality.

D. Interior Semi-Rigid Joint Fillers: For use at concrete slab saw-cuts, cold joints/construction joints and narrow cracks.

1. Industrial quality, two component, USDA approved, ASTM D2240, minimum Shore A 75-85, matching approximate color of natural concrete finish.

a. Epoxy Semi-Rigid Joint Filler: Intended for filling cracks and control joints subject to hard wheels and heavy loads.

1) Acceptable Manufacturers

- (a) Master Builder Solutions; MasterSeal CR 190.
- (b) Dayton Superior; Poxy Fil (J-52).
- (c) Euclid; EUCO 700 or EUCO 800.
- (d) US MIX; US SPEC, SR 50 EJF.
- (e) Vexcon; Power Coat Epoxy Flexible Joint Sealant.
- (f) W.R. Meadows; Rezi-Weld Flex.

b. Polyurea Semi-Rigid Joint Filler: Intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.

1) Acceptable Manufacturers:

- (a) Master Builder Solutions; MasterSeal CR 100.

- (b) Euclid; EUCO QWIKjoint 200.
- (c) L&M Construction Chemicals; Joint Tite 750.
- (d) VersaFlex; SL/75.

c. Substitutions under provisions of Section 012500.

2.6 CONTROL JOINT DEVICES

- A. Wall (below grade): Marflex Control Joint System (joint form, elastomeric sealant and fiberglass fabric reinforcement); (800-498-1411).
- B. Wall (above grade): Provide form material as required to produce control joints and rustication joints as shown on the drawings.
- C. Elevated Slab Control Joints (seismic joints): As detailed or approved by Engineer.
- D. Sealant and Primer: Type, as specified in Section 079200 - Joint Sealants.

2.7 CONCRETE MIX

- A. Provide concrete to meet all requirements shown on the drawings. The contractor is responsible for the preparation of design mixtures for each class of concrete used in construction.
- B. Select proportions for normal weight concrete in accordance with ACI 301 using the method of trial mixes.
- C. Calcium chloride not allowed in concrete.
- D. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94/C94M.
- E. For exposed slab-on-grade, conform to ASTM C157, and submit data showing length change not to exceed 0.05 percent.

PART 3 EXECUTION

3.1 GENERAL

- A. This section shall conform to requirements of ACI 301 specifications for Structural Concrete for buildings, except as modified by the supplemental requirements below.

3.2 EXAMINATION

- A. Verify site conditions under provisions of Section 013100 - Project Management and Coordination. Verify dimension with drawings.
- B. Verify requirements for concrete cover over reinforcement.

- C. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.3 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.
- B. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- C. Remove water from areas receiving concrete before concrete is placed.

3.4 PLACING CONCRETE

- A. Do not place concrete until installation of embedded electrical conduit is verified to conform to IBC requirements and notes on structural drawings.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, conduit, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.
- D. Clean formed cavities of debris prior to placing concrete.
- E. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- F. During cold weather, remove all ice, frost and snow from within forms and reinforcing. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
- G. Do not cast concrete against frozen surfaces. Refer to ACI-306.1 "Cold Weather Concrete" preparation before placing concrete.
- H. Maintain freshly placed concrete temperature at minimum 50 degrees Fahrenheit for 7 days, minimum.
- I. Place concrete in accordance with ACI 301, ACI 305.1 - Hot Weather Concreting, and ACI 306.1 - Cold Weather Concreting. Record daily High-Low temperatures at the site.
- J. Notify Architect and Special Inspector minimum 24 hours prior to commencement of operations.
- K. Ensure reinforcement, anchor rods, trench drains, inserts, embedded parts, formed joint fillers and utilities are not disturbed during concrete placement.

- L. Do not drop concrete freely more than 10 feet for concrete containing high-range water-reducing admixture (superplasticizer) or 5 feet for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
- M. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after its initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
- N. Concrete on Metal Deck: Class and minimum thickness shown. Provide uniform thickness of concrete as directed in the structural drawings, regardless of the deflection of the steel beams and the metal deck under the weight of wet concrete.
 - 1. Provide depressed slabs in locations indicated.
 - 2. Shores for metal deck shall be supported by the beams which support that deck element, and as directed by the Shoring Engineer.
 - 3. Allow for deflection of steel beams and metal deck under the weight of wet concrete in calculating concrete quantities for slab.
- O. Consolidation: Conform to ACI 309R. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 1.5 foot intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5,000 cycles per minute having an intensity sufficient to cause flow or settlement of concrete into place. Vibrator head to meet D.O.T. non-metal head specifications when using with epoxy coated rebar. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.
 - 1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
 - 2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.
- P. Maintain records of concrete placement. Record date, location, quantity, wind speed, rain, high and low air temperature, and test samples taken.
- Q. Place concrete continuously between predetermined joints.
- R. Do not interrupt successive placement; do not permit cold joints to occur.

3.5 PLACING CONCRETE SLABS

- A. Verify that base course has been prepared per Division 31 - Earthwork.

- B. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel.
- C. Set perimeter screed using either optical or laser instruments. Use rigid screed guides to control strikeoff elevation for all types of elevated slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.
- D. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.
- E. Use straight edges specifically made for screeding, such as hollow magnesium straightedges or power strikeoffs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strikeoff. Repeat strikeoff as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
- F. Immediately following screeding, and before any bleed water appears, use a 10-foot wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
- G. If saw cuts are used as an alternative to preformed slab joint, cut joints within 4 to 12 hours after placing, 4 hours in hot weather and 12 hours in cold. Using 3/16 inch thick blade, cut into 1/4 depth of slab thickness. Saw cuts must be in a straight line, with no deviation.
- H. Soff Cut or early entry saw-cutting equivalent may be used within 1 to 4 hours after placing as an alternate, provided manufacturer's recommendations are followed, 1 hour in hot weather and 4 hours in cold weather.
- I. Screed floors and slabs on grade level, maintaining surface flatness tolerances.
- J. Install joint fillers, primer and sealant in accordance with manufacturer's instructions. After full cure, shave joint filler flush with top of concrete slab.

3.6 SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen smooth substrate concrete surface per ACI 301 and remove deleterious material. Broom and vacuum clean.
- B. Place required dividers, edge strips, reinforcing, waterproofing membrane, insulation, and other items to be cast in.

- C. Apply bonding agent to substrate in accordance with manufacturer's instructions if required by topping manufacturer.
- D. Place concrete floor toppings to required lines and levels.
- E. Screed toppings level, maintaining surface flatness of maximum indicated in 033500 - Concrete Curing and Finishing, unless noted otherwise.

3.7 CONCRETE FINISHING

- A. Finish concrete floor surfaces to requirements of Section 033500 - Concrete Curing and Finishing.

3.8 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure concrete floor surfaces as specified in Section 033500 - Concrete Curing and Finishing. For general concrete curing refer to ACI 308.1.

3.9 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Field inspection and testing will be performed by Owner furnished testing laboratory as scheduled in the drawings.
- C. Provide inspection of concrete batch plant in accordance with ACI 301, Chapter 1 and schedule listed therein.
- D. For number and frequency of tests refer to Schedule - Testing.
- E. Provide free access to Work and cooperate with testing and special inspection firm.
- F. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- G. Tolerances not scheduled shall be in accordance with ACI 301, Chapter 1 and ACI-117.
- H. Evaluation and acceptance of concrete strength shall be in accordance with ACI 301.
- I. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

3.10 PATCHING

- A. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect/Engineer upon discovery.
- C. Patch imperfections to match original design intent. Use materials specified in Section 030100 - Maintenance of Concrete.

3.11 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, surface finish or specified requirements.
- B. Repair or replacement of defective concrete will be determined by Architect/Engineer.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.
- D. Refer to Specification Section 030100 - Concrete Repair, for repair instructions, and as directed by Architect.

3.12 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. Refer to Concrete Mix Design Table in the drawings, Section 033500 - Concrete Curing and Finishing, Section 033543 - Polished Concrete, and Finish and Color schedule.

END OF SECTION 033000

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Initial and final curing of horizontal and vertical concrete surfaces.
2. Finishing concrete floors and floor toppings.
3. Floor surface treatment.
4. Tolerances.

B. Related Sections:

1. Section 030100 - Concrete Repair
2. Section 031000 - Concrete Forming and Accessories.
3. Section 033000 - Cast-In-Place Concrete.
4. Section 079200 - Joint Sealants.
5. Section 079500 - Expansion Control.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
3. ACI 308.1 - Standard Specification for Curing Concrete.
4. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

5. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and of FL Floor Levelness Numbers.
 6. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- C. California Department of Health Services:
1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- D. South Coast Air Quality Management District:
1. SCAQMD Rule 1113 - January 1, 2004 - Architectural Coatings.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on concrete: hardener, sealer, curing compounds, curing sheets and slip resistant treatment; compatibilities and limitations.
- C. Sustainable Design Submittals
1. Section 018113 - Sustainable Design Requirements: Requirements for sustainable design submittals.
 2. General Emissions Evaluation: Provide documentation certifying paints and coatings were tested and determined compliant in accordance with current California Department Public Health Standard (CDPH) Method v1.2-2017 and complies with the VOC limits in Table 4-1 of the method.
 - a. Certification must state the exposure scenario used to determine compliance.
 3. VOC Content Evaluation: Provide documentation paints and coatings meet the VOC content limits outlined in California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings or South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
- D. Closeout Submittals
1. Section 017700 - Closeout Procedures.
 2. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 301 and ACI 302.1R.

B. Qualifications

1. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
2. Applicator/Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Temporary Lighting: Minimum 200 W light source, placed 8 feet (2.5 m) above floor surface, for each 425 sq ft (40 sq m) of floor being finished.
- C. Temporary Heat: Ambient temperature of 50 degrees F (10 degrees C) minimum.
- D. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.7 COORDINATION

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.
- B. Coordinate the Work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. The materials to be provided are to meet the guidelines for selection as available and as part of the total package developed, as defined in Section 018113 - Sustainable Design Requirements.
 1. Meet CDPH Standard Method emissions criteria.
 2. Comply with California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings or South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016.
 3. Methylene chloride and perchloroethylene may not be intentionally added.

- B. Compatibility: Determine compatibility of curing compounds with applied finishes and adhesives before starting work. Do not use incompatible products or when prohibited by resilient flooring or adhesive manufacturer. Provide curing/sealing products coordinated with the final approved flooring finishes selected.

2.2 FINISHING AND CURING MATERIALS

- A. Acceptable Manufacturers:
 - 1. US Spec.
 - 2. The Euclid Company.
 - 3. W.R. Meadows.
 - 4. Laticrete, L&M.
 - 5. Dayton Superior.
 - 6. Substitutions under provisions of Section 012500.
- B. Curing Compound:
 - 1. ASTM C309 Type 1-D, clear or translucent with fugitive dye, waterborne, membrane forming, and curing compound.
 - 2. ASTM C309, Type 1, Class B, clear or translucent resin-based, water-based curing compound.
- C. Sealing Compound: Hardener and dustproofer: Water based sodium silicate. Compound does not change the appearance of the concrete.
- D. Curing/Sealing Compound: ASTM C1315 Type 1, Class A 30% solids, clear without fugitive dye, waterborne membrane-forming curing and sealing compound. Comply with Federal Air Quality Regulations 40 CFR 52.254.
- E. Evaporation Retarder: Waterborne, monomolecular, film forming for application to fresh concrete.
- F. Removable Curing Compound: Removable, VOC compliant curing compound designed to be easily removed by the application of a cleaner. ASTM C309, Type 1, Class B, for interior use.
- G. Absorptive Mats: ASTM C171, cotton fabric or burlap-polyethylene, minimum 9 oz/sq yd (305 grams/sq m) bonded to prevent separation during handling and placing.
- H. Waterproof Paper: ASTM C171, curing paper treated to prevent separation during handling and placing, regular color.
- I. Polyethylene Film: ASTM C171, ASTM D2103, 6 mil, clear.

J. Curing Covers:

1. McTech Group, Inc.; Ultra Cure “NCF” or Ultra Cure “SUN.”
2. PNA Construction Technologies; S16 Hydracure Covers for single-use or M5 for multi-use.
3. Substitutions Section 012500 - Substitution Procedures.

K. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.
- B. Verify surfaces are acceptable to receive the Work of this section.

3.2 CURING - HORIZONTAL SURFACES

- A. Cure concrete in accordance with ACI 308.1 using one of the following methods:
 1. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 4 days.
 2. Spraying: Spray water (fog) over floor slab areas and maintain wet for 7 days.
 3. Absorptive Mat: Spread approved mat over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days.
 4. Absorptive Mat: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days.
 5. Membrane Curing Compound: Apply curing compound in compliance with manufacturer’s written recommendations.
 6. Non-Membrane Forming Curing Compound: Apply curing compound in one coat. Maintain surface wet with curing compound, without ponding for time recommended by manufacturer.
 7. Polyethylene Film: Spread over floor slab areas, lap edges and sides, seal with pressure sensitive tape; maintain in place for 7 days.

3.3 CURING - VERTICAL SURFACES

- A. Cure concrete in accordance with ACI 308.1 using one of the following methods:
 1. Spraying: Spray water over surfaces and maintain wet for 7 days.

2. Membrane Curing Compound: Apply compound in compliance with manufacturer's written recommendations.
3. Non-Membrane Forming Curing Compound: Apply curing compound in one coat. Maintain surface wet with curing compound for time recommended by manufacturer.

3.4 FLOOR SURFACE TREATMENT

- A. Apply hardener as scheduled on floor surfaces.
- B. Apply sealer as scheduled on floor surfaces.

3.5 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution: Protecting Installed Construction.
- B. Do not permit traffic over exposed concrete floor surface or stair treads and landings.

3.6 SCHEDULE - CONCRETE FINISHES

- A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.
- B. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 2 percent slope or as indicated on Drawings.
- C. Foundation Walls: Form finish with honeycomb and tie holes filled and fins removed unless noted otherwise.
- D. Underside of Supported Floors and Structure not Exposed to View: Form finish with holes and honey combs filled and surface finished unless noted otherwise.
- E. Underside of Supported Floors and Structure Exposed to View: Sack rubbed finish unless noted otherwise.
- F. Floor Surfaces to Receive Ceramic, Tile, Quarry Tile, Cementitious Terrazzo, Terrazzo on Full Bed Setting System or Concrete Topping: Wood Float unless noted otherwise.
- G. General Exposed Concrete Floor Surfaces and Surfaces to Receive Carpet, Resilient Flooring, Seamless Flooring, Thin Set Terrazzo, Thin Set Ceramic Tile, Thin Set Quarry Tile: Steel trowel unless noted otherwise.
- H. Special Exposed Concrete Floor Surfaces, see finish schedule and Section 033518 - Polished Concrete.
- I. Exterior Flatwork: Light Broom Finish unless noted otherwise.
- J. Interior Exposed Vertical Concrete: Smooth formed finish unless noted otherwise. Patch tile holes and defects. Remove fins exceeding 1/8 inch in height.

- K. Exterior Exposed Vertical Concrete Unless Noted Otherwise: Smooth form finished unless noted otherwise.
- L. Interior Stair Treads: Steel trowel finish unless noted otherwise. Acid wash and seal.
- M. For a blast finish, the degree of blasting is to be based on the following:
 - 1. Brush: Sufficient to dull surface sheen but not to have any reveal.
 - 2. Light: Maximum 1/16 inch aggregate exposure.
 - 3. Medium: Maximum 1/4 inch aggregate exposure.
 - 4. Heavy: Maximum 1/3 inch of the large aggregate diameter.

3.7 SCHEDULE - FLATWORK TOLERANCE

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Measure for FF and FL tolerances for floors in accordance with ASTM E1155, within 72 hours after slab installation.
- C. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:
 - 1. Slab-on grade areas covered with carpeting, or not specified otherwise in 2. below:
 - a. Specified overall value FF 25/FL 20
 - b. Minimum local value FF 17/FL 15
 - c. Level tolerance such that 80 percent of all points fall within a 3/4 inch envelope (+3/8 inch, -3/8 inch) from the design elevation.
 - 2. Slab-on grade areas that will be exposed, receive thin-set tile or resilient flooring:
 - a. Specified overall value FF 30/FL 20
 - b. Minimum local value FF 24/FL 15
 - c. Level tolerance such that 80 percent of all points fall within a 3/4 inch envelope (+3/8 inch, -3/8 inch) from the design elevation.
 - 3. Framed elevated floor areas covered with carpeting, or not specified otherwise in 4. below:
 - a. Specified overall value FF 25
 - b. Minimum local value FF 17

- c. Level tolerance such that 80 percent of all points fall within a 3/4 inch envelope (+3/8 inch, -3/8 inch) from the design elevation.
 - 4. Framed elevated floor areas that will be exposed, receive thin-set tile or resilient flooring:
 - a. Specified overall value FF 30
 - b. Minimum local value FF 24
 - c. Level tolerance such that 80 percent of all points fall within a 3/4 inch envelope (+3/8 inch, -3/8 inch) from the design elevation.
 - 5. Specified overall value is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.
- D. Measurements: Owner retained testing laboratory will take measurements to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays included). Make measurements before shores or forms are removed to insure the “as-built” levelness is accurately assessed. Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, “profileograph” or “dipstick”). Contractor’s surveyor shall establish reference elevations to be used by testing laboratory.
- E. Contractor not experienced in using FF and FL criteria is encouraged to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.
- F. Unacceptable Work: Individual slab section measuring less than either of specified minimum local FF/FL numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall FF/FL numbers, then whole slab shall be rejected and remedial measures shall be required.
- G. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding. Patching of low spots is not permitted. Repair or removal and replacement of entire rejected slab areas, as directed by Architect, until a slab finish constructed within specified tolerances is accepted. Grinding shall be done as soon as possible, preferably within three days, but not until concrete is sufficiently strong to prevent dislodging of coarse aggregate particles.
- H. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

3.8 SCHEDULE - CURING AND SEALING

- A. In general cure concrete surfaces in accordance with ACI 301 (Refer to Schedule Curing).
Apply compounds in accordance with manufacturer's instructions. Check for compatibility with finishes.
- B. Interior Flatwork:
 - 1. Typical:
 - a. Curing Compound without sealer.
 - b. Absorptive mats and polyethylene Film with sealing compound.
 - 2. Below grout set Flooring or Terrazzo:
 - a. Mats or Film without sealer.
 - 3. Below Adhesive applied Flooring and at Stained concrete:
 - a. Absorptive mats and polyethylene Film or Curing covers without sealer.
 - 4. Arrange Schedule for flatwork requiring adhesive applied flooring so that concrete will dry to meet the installation requirements of Division 9 Sections.

END OF SECTION 033500

DIVISION 05

METALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated metal items (as Detailed).
2. Custom Guardrails.
3. Structural supports.

B. Related Requirements:

1. Section 033000 - Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this Section in concrete.
2. Section 031000 - Concrete Forming and Accessories: Execution requirements for embedded anchors and attachments for metal fabrications specified by this Section in concrete.
3. Section 099000 - Painting and Coating: Field applied paint finish.

1.2 REFERENCE STANDARDS

A. Aluminum Association:

1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. American National Standards Institute:

1. ANSI A14.3 - Ladders - Fixed - Safety Requirements

D. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

2. ASTM A53/A53M- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
6. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts and Bolts for High Pressure or High Temperature Service, or Both.
7. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
8. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
9. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.
10. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
11. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
12. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
13. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
14. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
15. ASTM A554/A554M - Standard Specification for Welded Stainless Steel Mechanical Tubing.
16. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

18. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
19. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
20. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
21. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings.
22. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings.
23. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating.
24. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
25. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
26. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire.
27. ASTM B221/B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
28. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
29. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
30. ASTM F436/F436M - Standard Specification for Hardened Steel Washers.
31. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
32. ASTM F3125/F321M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Heat Treated, 120 and 105ksi Minimum Tensile Strength, Inch and Metric Dimensions.

E. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.6 - Structural Welding Code - Stainless Steel.

- F. Builders Hardware Manufacturers Association (BHMA):
 - 1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges, and Hasps.
- G. Green Seal:
 - 1. GC-03 - Green Seal Environmental Criteria for Anti-Corrosive Paints.
- H. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- I. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC SP 1 - Solvent Cleaning.
 - 3. SSPC SP 10 - Near-White Blast Cleaning.
 - 4. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
 - 5. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- 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. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Samples: Submit two 4" x 4" samples, illustrating factory finishes.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 QUALITY ASSURANCE

- A. Finish joints according to NOMMA Guideline 1.

1.5 QUALIFICATIONS

- A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept metal fabrications on-Site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 CUSTOM GRAUDRAILS

- A. Refer to Structural and Architectural details and fabricate from materials in this section.
- B. Railing assembly, wall rails and attachments to resist lateral force of 200 lbs. at any point without damage or permanent set. Test in accordance with ASTM E935.
- C. Comply with IBC 1607.8 Loads on handrails, guards, grab bars, seats, and vehicle barriers.

2.2 STRUCTURAL SUPPORTS

- A. Other Structural Supports: Steel sections, shape and size as indicated on Drawings or required to support applied loads with maximum deflection of 1/240 of the span; Interior: prime paint, one coat; exterior: galvanized (and paint if exposed 099000)] [mill finish].

2.3 MATERIALS

- A. Steel:
 - 1. Structural W-Shapes: ASTM A992 (A992M).
 - 2. Channels and Angles: ASTM A36 (A36M).
 - 3. Steel Plate: ASTM A572/A572M; Grade 50.
 - 4. Hollow Structural Sections (HSS): ASTM A500/A500M, Grade C.
 - 5. Steel Pipe: ASTM A53/A53M, Grade B.
 - 6. Sheet Steel: ASTM A653 (A653M), Grade 33 Structural Quality.
 - 7. Bolts: ASTM A307; Grade A or B, ASTM F3125/F3125M; Type 1.
 - 8. Nuts: ASTM A563 (A563M) heavy hex type.

9. Washers: ASTM F436 (F436M); Type 1.
10. Welding Materials: AWS D1.1; type required for materials being welded.
- B. Stainless Steel:
 1. Bars and Shapes: ASTM A276; Type 304.
 2. Tubing: ASTM A269; Type 304.
 3. Pipe: ASTM A312 (A312M), seamless; Type 304.
 4. Plate, Sheet, and Strip: ASTM A240 (A240M); Type 304.
 5. Bolts, Nuts, and Washers: ASTM A354.
 6. Welding Materials: AWS D1.6; type required for materials being welded.
- C. Aluminum:
 1. Extruded Aluminum: ASTM B221 (B221M) Alloy 6063, Temper T5.
 2. Sheet Aluminum: ASTM B209 (B209M) Alloy.
 3. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (B210M) Alloy 6063, Temper T6.
 4. Aluminum-Alloy Bars: ASTM B211 (B211M) Alloy 6063, Temper T6.
 5. Aluminum-Alloy Sand Castings: ASTM B26 (B26M).
 6. Aluminum-Alloy Die Castings: ASTM B85, Alloy as required to suit application.
 7. Bolts, Nuts, and Washers: Stainless steel.
 8. Welding Materials: AWS D1.1; type required for materials being welded.
- D. Bolts, Nuts, and Washers for Equipment and Piping:
 1. Carbon Steel:
 - a. Structural Connections: ASTM A307, Grade [A] [or] [B], hot-dip galvanized.
 - b. Anchor Bolts: [ASTM A307, Grade A] [ASTM A307, Grade B] [ASTM A36 (A36M), hot-dip galvanized.
 - c. Pipe and Equipment Flange Bolts: ASTM A193 (193M), Grade B-7.
 2. Stainless Steel: Type 316 stainless steel, class 2; ASTM A193 (193M) for bolts; ASTM A194 for nuts.

2.4 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. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish 2.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Fabrication Tolerances:
 - 1. Squareness: 1/8 in maximum difference in diagonal measurements.
 - 2. Maximum Offset between Faces: 1/16 in.
 - 3. Maximum Misalignment of Adjacent Members: 1/16 in.
 - 4. Maximum Bow: 1/8 inch in 48 in.
 - 5. Maximum Deviation from Plane: 1/16 inch in 48.

2.5 FINISHES

- A. Steel:
 - 1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 - 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
 - 3. Prime paint items with [one coat] [two coats] except where galvanizing is specified.
 - 4. Structural Steel Members: Refer to Section 051200.
 - 5. Galvanizing: ASTM A123 (A123M); hot-dip galvanize after fabrication.
 - 6. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153 (A153M).
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

7. Sheet Steel: Galvanized with G90 coating class.
 8. Bolts: Hot-dip galvanized.
 9. Nuts: Hot-dip galvanized.
 10. Washers: Hot-dip galvanized.
 11. Shop Primer: SSPC Paint 15, Type 1, red oxide.
 12. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic or Type II Organic.
- B. Stainless Steel:
1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.
- C. Aluminum:
1. Finish coatings to conform to AAMA 611. Comply with AA DAF-45.
 2. Exterior Aluminum Surfaces:
 - a. Exterior anodized to clear color, to 0.0007 in (0.018 mm) thickness.
 3. Interior Aluminum Surfaces:
 - a. Interior anodized to clear color, to 0.0007 in (0.018 mm) thickness.
 4. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Requirements for installation examination.
- B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip primed steel items to bare metal and aluminum where field welding is required.
- C. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Field weld components indicated on Drawings.
- D. Perform field welding according to AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 in (6 mm) per story or for every 12 ft (4 m) in height, whichever is greater, non-cumulative.
- C. Maximum Variation from Level: 1/16 inch (1.5 mm) in 3 ft (1 m) and 1/4 inch (6 mm) in 10 ft (3 m).
- D. Maximum Offset from Alignment: 1/4 in (6 mm).
- E. Maximum Out-of-Position: 1/4 in (6 mm).

3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Welding: Inspect welds according to AWS D1.1.
- D. Replace damaged or improperly functioning hardware.
- E. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.
- F. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for adjusting.
- B. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION 055000

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DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood panel products.
2. Lumber products.
3. Miscellaneous framing and sheathing.
4. Concealed wood blocking.
5. Sheathing and underlayment materials.
6. Fireblocking and draftstopping.
7. Fasteners and Anchors.
8. Accessories.
9. Factory wood treatment.

B. Related Sections:

1. Section 055000 - Metal Fabrications: Prefabricated steel structural supports.
2. Section 099000 - Painting and Coating

1.2 REFERENCES

A. American Wood Protection Association:

1. AWWPA U1 - Use Category System: User Specification for Treated Wood.

B. APA - The Engineered Wood Association:

1. APA - Plywood Design Specification, including supplements.
2. APA AFG-01 - Adhesives for Field-Gluing Plywood to Wood Framing.

C. APA PS 1 - Voluntary Product Standard - Structural Plywood

D. American Society for Testing and Materials:

1. ASTM A123/A123M - Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products.
2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.

3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
 4. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
 5. ASTM D226/D226M - Standard Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 7. ASTM E119/E119M - Standard Test Methods for Fire Tests of Building Construction and Materials.
 8. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- E. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- F. Underwriters Laboratories Inc.:
1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- G. U.S. Department of Commerce - National Institute of Standards and Technology:
1. DOC PS 1 - Structural Plywood.
 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
 3. DOC PS 20 - American Softwood Lumber Standard.

1.3 COORDINATION

- A. Section 013000 - Administrative Requirements: Requirements for coordination.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit technical data on wood preservative materials, and application instructions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. Lumber Grading Agency: Certified by DOC PS 20.

2. Wood Structural Panel Grading Agency: Certified by APA - The Engineered Wood Association.
- B. Fire Rated Wall Construction: Rating as indicated on Drawings.
 1. Tested Rating: Determined in accordance with ASTM E119.
- C. Surface Burning Characteristics:
 1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- D. Apply label from agency approved by authority having jurisdiction to identify each fire retardant treated material.
- E. Perform Work in accordance with IBC standards.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
- B. The materials to be provided are to meet the guidelines for selection as available and as part of the total package developed, as defined in Section 018113 - Sustainable Design Requirements.
 1. When using composite wood, provide materials that are NAF (No Added Formaldehyde) or ULEF (Ultra Low Emitting Formaldehyde).

2.2 LUMBER MATERIALS

- A. Non-structural Light Framing: Douglas Fir/Larch, No 2 and better, 19 percent maximum moisture content.
- B. Studding: Douglas Fir/Larch, No 2 and better, 19 percent maximum moisture content.
- C. Miscellaneous Framing and blocking: Douglas Fir/Larch, No 2 and better, 19 percent maximum moisture content, pressure preservative treat.

2.3 WOOD PANEL PRODUCTS

- A. APA Grade Stamp each panel. Conform to DOC PS 1 and DOC PS 2 for cross-laminated veneer panel.
 - 1. APA PS 1, A-C Group 1, Exposure 1: Face exposed one side.
 - 2. Where A side of face of plywood is left exposed as finish or room interior, ensure no wood stamp is present on face and no paint on sides.
- B. Communications and Electrical Panel Boards: $\frac{3}{4}$ inch Plywood to be painted with fire retardant coating per Specification Section 099000 - Painting and Coating or Type AC fire rated plywood with A side facing out.
- C. Roof Sheathing: APA Rated Sheathing; Span Rating 24/0; Exposure Durability 1 exterior.
- D. Sloped Roof Sheathing: Refer to structural for thickness and Span Rating 48 x 96 inch sized sheets, square edges.
- E. Above Grade Wall Sheathing: Refer to structural for thickness and Span Rating, 48 x 96 inch sized sheets, square edges, fire-retardant-treated.
- F. Subflooring: APA Rated Sheathing Exposure 1.
 - 1. APA Span Rating: Refer to Structural drawings.
 - 2. Thickness: Refer to Structural drawings.
 - 3. T&G edges.
 - 4. Sanded both sides.
- G. Floor Underlayment: APA Underlayment Group 1 Exposure 1.
 - 1. Non-spanning underlayment for finish flooring systems over plywood subflooring.
 - 2. $\frac{3}{8}$ inches thick, unless otherwise noted.
 - 3. Sanded.

2.4 FASTENERS AND ANCHORS

- A. Fasteners: ASTM A153/A153M, hot dipped galvanized or ASTM B695, Class 55 mechanically galvanized, 304 stainless steel for high humidity and treated wood locations, unfinished steel elsewhere.
- B. Nails: ASTM F1667.
- C. Anchors: Adhesive anchor with screen type for anchorage to hollow masonry. Expansion bolt and screw anchor type for anchorage to solid masonry or concrete. A307 Bolt, Self Drilling Screw or ballistic fastener for anchorages to steel. All material to be zinc coated or stainless steel.
- D. Structural Steel Framing Connectors: All hardware in contact with preservative treated wood shall be grade 316 stainless steel per ASTM A653. Use Sizes to suit framing conditions.

2.5 ACCESSORIES

- A. Provide polymeric membrane material as a barrier between copper containing preservative treated lumber and steel deck products, metal panels, and accessory metal materials.

2.6 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWWA Treatment U1 using water borne preservative with 0.25percent retainage.
- B. Treat with wood preservative any wood to come in contact with concrete.
- C. Fire Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested in accordance with ASTM E84 and showing no evidence of significant progressive combustion when test is continued for an additional 20 minute period, Interior Type.
- D. Moisture Content after Treatment: Kiln dried (KDAT).
 - 1. Lumber: Maximum 19 percent.
 - 2. Structural Panels: Maximum 15 percent.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 COMMUNICATIONS AND ELECTRICAL ROOM PANEL BOARDS

- A. Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board. Install with wood structural panel where required.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.3 SUBFLOORING AND UNDERLAYMENT

- A. Maintain 1/8 inch space between sheathing panel end and edge joints.
- B. Subfloor: Glue to framing with construction adhesive and nail with ring-shank nails or screw shank nails. Space fasteners to penetrate fully into solid framing. Conform to Structural Drawings.
 - 1. Edge Nail Spacing: 6 inch on center, except 12 inch each way for subfloor under 3/4 inch thick.
 - 2. Panel Face Nail Spacing: 12 inch on center each way.
- C. Flooring Underlayment: Lay with staggered joints over dry subflooring.
 - 1. Nail with ring shank-nails.
 - 2. Space fasteners so as not to penetrate framing.
 - 3. Allow 1/32 inch space between joints.
 - 4. Set nails and patch as necessary to prevent telegraphing through finish flooring.
 - 5. Do not use staples.

3.4 FRAMING

- A. Set structural members level and plumb, in correct position.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- C. Place horizontal members, crown side up.
- D. Construct load bearing framing and curb members full length without splices.
- E. Double members at openings as noted on structural drawings.

- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions parallel to floor joists. Frame rigidly into joists.
- G. Bridge joists as detailed. Fit solid blocking at ends of members where indicated.
- H. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

3.5 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment.
- B. Brush apply one coat of preservative treatment on wood in contact with cementitious materials; roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.6 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Framing Members: 1/4 inch from indicated position, maximum.

3.7 SCHEDULES

- A. Provide products of this section where detailed or indicated.

END OF SECTION 061000

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Parallam Beam, columns and posts for roof and floor framing (PSL).
2. Laminated Veneer Lumber (LVL) beams.
3. Laminated Strand Lumber (LSL).
4. Rim Boards.
5. Bridging, bracing and anchorage.
6. Framing for openings.

B. Related Sections:

1. Section 033000 - Cast-In-Place Concrete: Setting anchors in concrete.
2. Section 042016 - Concrete Unit Masonry: Setting anchors in masonry.
3. Section 061000 - Rough Carpentry: Framing and Sheathing.

1.2 REFERENCES

A. American National Standard:

1. ANSI A208.1 - American National Standard Particleboard.

B. ASTM International:

1. ASTM A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
3. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
4. ASTM D5456 - Standard Specification for Evaluation of Structural Composite Lumber Products.
5. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate sizes and spacing of studs, beams, loads, framed openings and beam camber. Submit design calculations.
- C. Product Data: Submit Beam and Stud configurations, bearing and anchor details, bridging, bracing and installation instructions
- D. ICC report.
- E. Sustainability Submittal Requirements: Refer to Section 018113 - Sustainable Design Requirements for submittals required by this Section to meet the sustainability goals for this Project.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following agencies:
 - 1. Lumber Grading Agency: Certified by ALSC.
 - 2. Plywood Grading Agency: Certified by APA.
- B. Joists detailed and installed in accordance with current National Evaluation Report or ICC, Engineering Service Report.
- C. Design and manufacture products to be custom fit to dimensions and loads indicated on drawings in accordance with ASTM D5456.
 - 1. Tested Rating: Determined in accordance with ASTM E119.
- D. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - 2. Design joists and associated components under direct supervision of Professional Engineer experienced in design of this Work and licensed in State where Project is located.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Protect structural components from warping or other distortion by stacking in vertical position, braced to resist movement. Protect from weather.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. The materials to be provided are to meet the guidelines for selection as available and as part of the total package developed, as defined in Section 018113 - Sustainability Requirements.
 - 1. When using composite wood, provide materials that are NAF (No Added Formaldehyde) or ULEF (Ultra Low Emitting Formaldehyde).

2.2 MATERIALS

- A. Laminated Veneer Lumber (LVL): Conforming to ASTM D5456.
 - 1. Acceptable Manufacturers:
 - a. Boise Cascade Corp. - Versa-Lam.
 - b. RedBuilt - Redlam.
 - c. Murphy - LVL Structural Lumber.
 - d. Substitutions under provisions of Section 012500.
 - 2. Product made from Douglas Fir or Southern Pine veneers with all grain parallel to the member, laminated with adhesives which comply with ASTM D2559. The glue line is parallel to the wide face of the member.
 - 3. Minimum Allowable Stresses (unless noted on drawings):
 - a. Flexural stress in bending $F_b = 2,900$ psi.
 - b. Compression perpendicular to grain $F_{c1} = 750$ psi.
 - c. Horizontal shear $F_v = 285$ psi.
 - d. Modulus of elasticity $E = 1,900,000$ psi.
- B. Laminated Strand Lumber (LSL): Conforming to ASTM D5456.
 - 1. To be used only where specifically designated on the structural drawings.
 - 2. Acceptable Manufacturers:
 - a. Weyerhaeuser - Timberstrand.
 - b. Substitutions under provisions of Section 012500.
 - 3. Product is made from oriented strand board ANSI A208.1; wood flakes set with waterproof resin binder; unsanded faces meeting requirements of PSI-83, Structural 1.

- a. Minimum Allowable Stresses (unless noted on the drawings):
 - 1) Shear modulus of elasticity $G = 81,250$ psi.
 - 2) Modulus of elasticity $E = 1.3 \times 10^6$ psi.
 - 3) Flexural stress in bending $F_b = 1,700$ psi.
 - 4) Compression perpendicular to grain parallel to wide face of strands $F_{c1} = 680$ psi.
 - 5) Compression parallel to grain $F_{c11} = 1,400$ psi.
 - 6) Horizontal shear perpendicular to wide face of strands $F_v = 400$ psi.
- C. Parallel Strand Lumber (PSL): Conforming to ASTM D5456.
 - 1. Acceptable Manufacturers:
 - a. Weyerhaeuser, Parallam. ICC ES ESR-1387.
 - 2. Substitutions: Refer to 012500 - Substitution Procedures.
 - 3. Product is made from oriented strands in longitudinal direction of member.
 - 4. Minimum Allowable Beam Stresses:
 - a. Shear Modulus of Elasticity - $G = 137,500$ psi.
 - b. Modulus of Elasticity - $E = 2.2 \times 10^6$ psi.
 - c. Flexural Stress - $F_b = 2,900$ psi. (For member depths of 12 inch or less. Depths greater than 12 inch per latest National Design Specification for Wood Construction.)
 - d. Compression Perpendicular to Grain - $F_{c1} = 750$ psi. (May not be increased for duration of load.)
 - e. Compression Parallel to Grain - $F_{c11} = 2,900$ psi.
 - f. Horizontal Shear Parallel to Grain - $F_v = 290$ psi.
 - g. Equivalent Specific Gravity - $SG = 0.50$ (For lateral connection design only.)
 - h. Density = 45lbs/ft³.
 - 5. Minimum Allowable Column and Post Stresses:
 - a. Modulus of Elasticity - $E = 1.8 \times 10^6$ psi.
 - b. Flexural Stress - $F_b = 2,400$ psi.

- c. Compression Parallel to Grain - $F_{cll} = 2,500$ psi.
 - d. Equivalent Specific Gravity - $SG = 0.50$. (For lateral connection design only.)
 - e. Density = 45lbs/ft³.
6. Joist Bridging and Bracing: Design and supply by joist manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.
- B. Verify supports are ready to receive members.

3.2 PREPARATION

- A. Coordinate placement of bearing and support items.
- B. Do not allow notches or holes to be cut in members unless detailed on the drawings.

3.3 ERECTION

- A. Install members in accordance with manufacturer's instructions.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in alignment until completion of erection and installation of permanent bracing.
- C. Place headers and supports to frame openings.
- D. Frame openings between members with lumber in accordance with Section 061000.
- E. Coordinate placement of sheathing and decking with Work of this section.

3.4 SITE APPLIED WOOD TREATMENT

- A. Brush apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings. Treat site-sawn cuts.
- B. Allow preservative to dry prior to erecting members.

3.5 ERECTION TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Framing Members: 1/2 inch maximum, from indicated position.

END OF SECTION 061700

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glued-laminated timber beams.
2. Preservative treatment of wood.
3. Fire retardant treatment of wood.
4. Steel hardware, connections, and attachment brackets.

B. Related Requirements:

1. Section 061000 - Rough Carpentry: Roof sheathing.
2. Section 099000 - Painting and Coating: Field finishing.

1.2 REFERENCE STANDARDS

A. American Institute of Timber Construction:

1. AITC 109 - Standard for Preservative Treatment of Structural Glued Laminated Timber.
2. AITC 110 - Standard Appearance Grades for Structural Glued Laminated Timber.
3. AITC 111 - Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection.
4. AITC 113 - Standard for Dimensions of Structural Glued Laminated Timber.
5. AITC 117 - Standard Specifications for Structural Glued Laminated Timber of Softwood Species.
6. AITC 119 - Standard Specifications for Structural Glued Laminated Timber of Hardwood Species.

B. American National Standards Institute:

1. ANSI A190.1 - Standard for Wood Products - Structural Glued Laminated Timber.

C. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A36M - Standard Specification for Carbon Structural Steel.

3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153- Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
8. ASTM A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength.
12. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
13. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts
14. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
15. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
16. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
17. ASTM D3737 - Standard Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam).
18. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

19. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength.
 20. ASTM F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength.
- D. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
- E. American Wood Protection Association:
1. AWPAC U1 - Use Category System: User Specification for Treated Wood.
- F. APA - The Engineered Wood Association:
1. APA/EWA - Plywood Design Specification.
- G. California Department of Health Care Services:
1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (includes Addendum 2004).
- H. Forest Stewardship Council:
1. FSC Guidelines.
- I. Green Seal:
1. GC-3- Green Seal Environmental Criteria for Anti-Corrosive Paints.
- J. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
- 1.3 COORDINATION
- A. Section 013100 - Project Management and Coordination: Requirements for coordination.
 - B. Coordinate Work of this Section with placement of support items.
- 1.4 SUBMITTALS
- A. Section 013300 - Submittal Procedures: Requirements for submittals.
 - B. Product Data: Submit technical data on wood preservative materials, application techniques, and resultant performance information.

- C. Shop Drawings: Indicate framing systems, connections, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, and framed openings.
- D. Samples: Submit two factory-finished wood samples using specified wood species and grade, 6 inches by 6 inches in size, illustrating sheen and full range of color to be provided in glued-laminated members.
- E. Manufacturer's/Fabricator's Certificate: Certify that products meet or exceed specified requirements.
- F. Qualifications Statements:
 - 1. Submit qualifications for manufacturer/fabricator, erector, and licensed professional.
- G. Sustainable Design Submittals
 - 1. Section 018113 - Sustainable Design Requirements: Requirements for sustainable design submittals.

1.5 QUALITY ASSURANCE

- A. Perform Work as Follows:
 - 1. Glued-Laminated Timber Fabrication: Comply with ANSI A190.1.
 - 2. Connector Welding: Comply with AWS D1.1 (D1.1M).
 - 3. Preservative Treatment: Comply with AITC 109.
- B. Glued-Laminated Timber Structural Capacities: Determine according to ASTM D3737.
- C. Surface Burning Characteristics:
 - 1. Fire-Retardant-Treated Materials: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- D. Apply label from agency approved by authority having jurisdiction to identify each pervative-treated and fire-retardant-treated material.

1.6 QUALIFICATIONS

- A. Manufacturer/Fabricator: Company specializing in manufacturing products specified in this Section with minimum three years' experience and certified by AITC or APA/EWA.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience.
- C. Licensed Professional: Profesional engineer experienced in design of specified Work and licensed in State of Washington.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Do not store directly on ground or pavement.
 - 3. Allow air circulation on each side of wrapping and bundles.
- D. Protection:
 - 1. Slit or puncture lowest side of manufacturer wrapping that is left in place during storage to prevent moisture accumulation inside wrapping.
 - 2. Protect members according to AITC 111 for individually wrapped materials.
 - 3. Leave individual wrapping in place until materials receive finish coating.
 - 4. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Section 017700 - Closeout Procedures.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Refer to General Structural Notes (Sheets S001, and S002).
- B. Design and laminate members according to AITC 117.
- C. Sustainability Requirements:
 - 1. Section 018113 - Sustainable Design Requirements: Requirements for sustainable design compliance.

2.2 ACCEPTABLE MANUFACTURERS:

- A. Boise Cascade.
- B. Red Built.
- C. QB Corporation.
- D. Substitutions under provisions of Section 012500.

2.3 GLUED-LAMINATED UNITS

- A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Architectural grade.
 - 1. Verify dimensions and site conditions prior to fabrication.
 - 2. Cut and fit members accurately to length to achieve tight joint fit.
 - 3. Fabricate member with camber built in.
 - 4. Do not splice or join members in locations other than those indicated without permission.
 - 5. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
 - 6. Welding: Perform welding in accordance with AWS D1.1/D1.1M.
 - 7. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
- B. Performance Criteria:
 - 1. Comply with applicable code for loads, seismic zoning, and other load criteria.

2.4 MATERIALS

- A. Lumber: Softwood lumber complying with RIS (GR) grading rules with 12 percent maximum moisture content before fabrication.
 - 1. Lumber fabricated from old growth timber is not permitted.
- B. Steel Connections and Brackets:
 - 1. Comply with ASTM A36/A36M.
 - 2. Quality: Weldable.
 - 3. Finish: Galvanized.

- C. Anchor Bolts: ASTM F3125/F3125M, Type 1 heavy hex high strength bolts and ASTM A563 (ASTM A563M) nuts; hot-dip galvanized to meet requirements of ASTM A153/A153M, matching washers.
- D. Laminating Adhesive:
 - 1. Comply with ASTM A2559.
- E. Bearing Plate Anchors: Adhesive anchor to anchor to hollow masonry. Expansion shield and lag bolt type to anchor to solid masonry or concrete. Bolts or ballistic fasteners to anchor to steel.

2.5 WOOD TREATMENT

- A. Refer to Section 061000.

2.6 FABRICATION

- A. Fabricate glued-laminated structural members according to ANSI/AITC A190.1
 - 1. Stamp members with AITC Quality Mark in a location which will be concealed from view in its as-built condition
 - 2. For conditions where quality mark stamp cannot be concealed, accompany member with an AITC Certificate of Conformance.
- B. Grade: Architectural. See structural Notes.
- C. Layup:
 - 1. Unbalanced, unless noted otherwise
 - a. Apply TOP stamp
 - 1) On the top of the member
 - 2) At both ends
 - 3) Spaced at a maximum of 8 feet
 - 4) In letters at least 2" in height
- D. Cut and fit members accurately to length to achieve tight joint fit.
- E. Camber: 2000 foot radius unless noted otherwise. No camber on cantilever members or members continuous over supports.
- F. Do not splice or join members without permission from authority having jurisdiction in locations other than those indicated.

- G. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
- H. Sealer: After fabrication, apply one coat of manufacturer's standard penetrating clear sealer to cut end surface according to AITC or APA/EWA requirements.

2.7 FINISHES

- A. Field Finishing of Members: As specified in Section 099000 - Painting and Coating.

2.8 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Inspection: Inspect Work performed at manufacturer's/fabricator's facility to verify conformance to Contract Documents.
- C. Certificate of Compliance:
 - 1. If manufacturer/fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's/fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved manufacturer/fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 017000 - Execution: Requirements for erection examination.
- B. Verify that supports are ready to receive units.
- C. Verify that there is sufficient end bearing area.

3.2 PREPARATION

- A. Coordinate placement of bearing items.

3.3 ERECTION

- A. Comply with AITC 111.
- B. Lift members using protective straps to prevent visible damage.
- C. Set structural members level, plumb, with camber up, in correct positions, and sloped where indicated.
- D. Install temporary bracing and anchorage to hold members in place until permanently secured.

- E. Fit members together accurately without trimming, cutting, or other unauthorized modification.
- F. Swab and seal with primer interior wood surfaces of field-drilled holes in members.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Indicated Position:
 - 1. Framing Members: ½ inch.

3.5 PROTECTION

- A. Section 017000 - Execution: Requirements for protecting finished Work.
- B. Do not remove factory protective wrapping until after installation of roof deck and water-resistant membrane.

3.6 SCHEDULE - FINISH

- A. Exposed to View: Architectural Appearance Grade per AITC 110-2001.
- B. Non-Exposed to View Members: Industrial Appearance Grade per AITC 110-2001.

END OF SECTION 061800

DIVISION 07

THERMAL AND MOISTURE PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Repair of existing roof systems at areas of new mechanical roof openings.
 - 2. Temporary roofing protection.
 - 3. Alternate Bid 4. Patch roof at new mechanical unit.
- B. Related Sections:
 - 1. Section 024119 - Selective Demolition.
 - 2. Section 028200 - Asbestos Abatement Submittal.
 - 3. Division 23 Heating, Ventilation and Air Conditioning HVAC.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Attendees:
 - a. Integrus Architecture.
 - b. Contractor.
 - c. Owner.
 - d. Roofing membrane installer.
 - 2. Meeting Agenda: Provide agenda to participants prior to meeting in preparation for discussions on the following:
 - a. Removal and installation schedule.
 - b. Necessary preparatory work.
 - c. Protection before, during, and after roofing system installation.
- B. Schedule work to coincide with commencement of installation of new mechanical roof openings.

1.3 SUBMITTALS

- A. Refer to Section 013300.
- B. Shop Drawings: Indicate size, configuration, and installation details.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Company specializing in performing work of the type specified and with at least three years of documented experience.
2. Cut, patch, and repair existing work using skilled specialists, qualified to perform work in a manner to cause least damage of work to remain.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

1.6 FIELD CONDITIONS

- A. Existing Roofing System: Modified bituminous roofing systems.
- B. Do not remove existing roofing membrane when weather conditions threaten the integrity of building contents or intended continued occupancy.
- C. Maintain continuous temporary protection prior to and during installation of new roofing system to keep the building weather tight.
- D. Provide notice at least three days before starting activities that will affect normal building operations.
- E. Owner will occupy building areas directly below re-roofing area.
1. Provide Owner with at least 48 hours written notice of roofing activities that may affect their operations and to allow them to prepare for upcoming activities as necessary.
 2. Do not disrupt Owner's operations or activities.
 3. Maintain access of Owner's personnel to corridors, existing walkways, and adjacent buildings.

1.7 SCHEDULING

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.
- B. Schedule Work to coincide with commencement of installation of roofing repair.

1.8 COORDINATION

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.

- B. Remove only existing roofing materials that can be replaced with new materials as the weather will permit.
- C. Coordinate the Work with other affected mechanical and electrical work associated with roof penetrations.

1.9 WARRANTY

- A. Existing Warranties: Perform this work using methods and materials that will maintain existing roof system warranties.
 - 1. Notify existing roof system warrantor prior to starting this work and obtain written instructions for procedures necessary to maintain this existing warranty.
 - 2. Upon completion of this work, notify warrantor of reroofing completion and obtain documentation to verify that existing roofing system has been inspected and warranty is still in effect.
 - a. Submit documentation upon project closeout.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Patching Materials: Provide necessary materials in accordance with requirements of existing roofing system.
- B. Roofing Repair as Required: Remove existing Modified Bituminous roofing membrane and components of existing roofing system down to existing metal roof deck as required for buildup of new mechanical curbs. Patch and repair roofing where new equipment is to be installed per the drawings. Layout indicated in the drawings is for reference only and exact locations should be coordinated with the Owner and final equipment locations.
- C. Temporary Roofing Protection Materials:
 - 1. Contractor's responsibility to select appropriate materials for temporary protection of roofing areas as determined necessary for this work.
- D. All materials to match existing roofing system.

2.2 ACCESSORIES

- A. Fasteners: Type and size as required and compatible with existing and new roofing system to resist local wind uplift.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013100 – Project Management and Coordination: Coordination and project conditions.
- B. Verify that existing roof surface has been cleared of materials being removed from existing roofing system and ready for next phase of work as required.

3.2 PREPARATION

- A. Sweep roof surface clean of loose matter.
- B. Remove loose refuse and dispose of properly off-site.

3.3 INSTALLATION

- A. Coordinate scope of this work with requirements for installation of new mechanical roof openings. Refer to related roofing section for additional requirements.

3.4 EXISTING CONSTRUCTION

- A. Remove membrane insulation and related roofing components in preparation for replacement membrane roof system specified herein.
- B. Repair existing metal deck surface as necessary to provide smooth working surface for replacement roof system.
- C. Construct mechanical curb as detailed on Drawings.
- D. Replace insulation and roofing materials that have been removed for construction of curb.
- E. Replace or repair flexible sheet base flashings to seal membrane to vertical elements. Reinforce as recommended by roofing membrane manufacturer.
- F. Obtain approval from the roofing manufacturer providing the warranty on existing roof.

3.5 PROTECTION

- A. Provide protection of existing roofing system that is not having work performed on it.
- B. Provide temporary protective sheeting over uncovered deck surfaces.
- C. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- D. Provide for surface drainage from sheeting to existing drainage facilities.
- E. Do not permit traffic over unprotected or repaired deck surface.

END OF SECTION 070150

DIVISION 23
HEATING, VENTILATING, AND
AIR CONDITIONING (HVAC)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Duct Cleaning
- B. Air Inlet/Outlet Cleaning
- C. HVAC Unit Cleaning
- D. Ductwork Repairs
- E. HVAC Unit Filters
- F. Cleaning Report

1.03 CONTRACTOR QUALIFICATIONS

- A. Contractor performing work of this section shall be a firm that regularly engages in the cleaning of air distribution systems and shall have been in such business for a minimum of three years.
- B. Contractor shall have satisfactorily completed at least five cleaning projects similar in size and nature as this project within the last 5 years.

1.04 SUBMITTALS

- A. General: Shall comply with Section 23 05 00.
- B. Qualifications: Name and qualifications of proposed Cleaning Contractor, list of equipment, personnel, past projects (similar in size and nature as this project) and experience.
- C. Cleaning Plan: Proposed cleaning plan, including cleaning methods equipment, products, and schedule as to when the work will occur and the sequence.
- D. Chemicals: Provide Material Safety Data Sheets (MSDS's) for all chemical products to be used.

1.05 GENERAL REQUIREMENTS

- A. Time of Work: All cleaning work shall be accomplished between the hours of 5pm and 6am (i.e. evening through early morning). Coordinate all activities with Owner.
- B. Pre-Cleaning Meeting: A pre-cleaning meeting will be held at least 14 days prior to any cleaning activity starting. Attendees at the meeting shall include representatives of the building owner, mechanical engineer, cleaning agency, general contractor and HVAC/sheet metal subcontractors. The meeting shall include a review and discussion of the Contractors

proposed methods, scheduling, duct repairs, duct access, and related issues.

1.06 BIDDING

- A. See Divisions 00 & 01.

PART 2 - PRODUCTS

2.01 INSPECTION EQUIPMENT

- A. Fiberoptic borescope with 35mm single lens camera and high intensity portable light source.

2.02 CLEANING EQUIPMENT

- A. General: Equipment shall be capable of completely cleaning the ductwork and systems involved in this project.
- B. Cleaning equipment shall include mechanical brushes, oscillating brush systems (pneumatic or electric driven), spray nozzles, vacuum equipment and connecting accessories, air compressor and high pressure air jet accessories, steam cleaning apparatus and related general cleaning equipment/tools.
- C. Cleaning equipment shall be of the type so as to allow complete cleaning of all specified systems.
- D. Equipment shall be in good working order, so as to provide optimum results.

2.03 APPLIED MATERIALS

- A. Non-Acid Biodegradable Cleaning Agent: Abatement Technologies "Vent-Clean", or equal.
- B. Non-Acid Biodegradable Coil Cleaning Agent: Abatement Technologies; Coil Clean, or equal.
- C. Fiberglass Lagging: Borden Dip Lag.
- D. Fiberglass Sealant/Encapsulant: Fosters 40-10, 40-20, or 40-23.
- E. Fiberglass: Owens/Corning or equivalent.
- F. Polymetric Rust Converter: National Chemsearch "Conquest".
- G. Primer/Paint: Fosters 40-26/Portersept.
- H. Bonded Dry Film Lubricant: Dow Corning 321R.
- I. Disinfectant/Sanitizer: BIO-CIDE International "Oxine AD".

2.04 DUCT MATERIALS

- A. Duct Access Doors: See Section 23 33 00.
- B. Building Access Doors: See Section 23 33 00.

- C. Ductwork: For ductwork, flexible ductwork, and duct lining see Section 23 31 00.

PART 3 - EXECUTION

3.01 GENERAL

A. Scope:

1. Clean the interior surfaces of all ductwork and components installed in ductwork (i.e. dampers, turning vanes, control sensors, etc.).
2. Clean the interior surfaces of all air handling equipment and components installed in equipment that come in contact with airflow (i.e. fans, plenums, drain pans, filter assemblies, coils, etc.).
3. Clean the interior and exterior surfaces of all inlets and outlets and components within (i.e. dampers, control sensors, etc.).
4. Items cleaned shall be free of any dust, dirt, debris, or films after cleaning.

B. Protection:

1. Contractor shall limit his equipment capacity and methods as necessary to prevent excessive vacuum or pressure from damaging any items and/or provide pressure/vacuum relief devices as required.
2. Contractor shall protect all building property, building occupants, and the overall environmental integrity of the building.
3. Provide 2 mil plastic or equivalent sheeting over interior building features (walls, desks, carpets, etc.).
4. Provide temporary filter-media blankets in all grilles, registers and diffusers to restrict residual debris that can expel from the duct system during cleaning and remediation processes.

- C. Damage: Contractor shall repair or replace at his own expense any items damaged in the course of performing this work. Such repair or replacement shall restore the damaged item to its pre-construction condition (or better), shall comply with the pertinent sections of these specifications, and shall be done to the satisfaction of the Owner. Such repair includes damaged air inlets/outlets, duct lining, duct insulation, flexible duct, flexible duct connections, walls, flooring, ceiling tile, etc.

- D. Flexible Duct Replacement: The Contractor shall either replace all existing flexible duct with new, or remove and clean the existing flexible duct and reinstall. The Contractor shall coordinate this work with other trades for proper division of work among sub-contractors.

3.02 EQUIPMENT

- A. General: Equipment shall be of configuration, capacity and with all necessary hoses, fittings, nozzles, adapters, etc. to allow full and complete cleaning of the duct systems.
- B. Cleaning agency shall provide all necessary equipment, instrumentation and materials for testing, cleaning, repairing all specified systems.

3.03 CLEANING

- A. Methods-Ductwork: Cleaning shall be done by applying a high capacity power vacuum to one end of the ductwork and applying high pressure compressed air spray to the other end of the duct and by using direct contact branches on all sides of the ductwork. Where internally lined ductwork exists, a non-contact cleaning method shall be used. The compressed air spray shall be fed down through the duct to blast the system clean back to the vacuum hose.
- B. Methods-Equipment: Air handling units, fans, coils, and similar items shall be cleaned by steam cleaning and with hot water pressure washing equipment. Sanitize all areas after cleaning. All corrosion and damaged metal areas shall be cleaned, with a prime paint applied after cleaning. All damaged unit internal lining, insulation, and related components shall be repaired. Contractor shall base bids on assuming 100 square feet of existing damaged duct lining per air handling unit, and 20 square feet of corroded metal per unit. Provide new filters for all air handling units cleaned. Filters shall be the same as those specified for new heat pumps, but size and thickness to match existing units.
- C. Access: The Contractor of this section shall be responsible for providing all access to ductwork into ductwork, and to accessories. This includes cutting ceiling openings, removing air inlets/outlets, removing flexible ducts, cutting access openings into ductwork, etc. All items removed (or accessed) shall be restored to a condition equal to or better than before construction when work is complete. This includes re-installing all air inlets/outlets, patching duct openings, installing building access doors in ceiling, reattaching (or replacing) flexible ducts, readjusting disturbed air outlet adjustment vanes, etc.
- D. Protection of Cleaned Ducts: In areas where construction (or duct cleaning) may occur after ducts have been cleaned, Contractor shall provide temporary air filters at all duct openings to prevent the possible re-contamination of the ducts.

3.04 INSPECTION AND REPORT

- A. Prior to completing cleaning of more than 20% of the ductwork, the Contractor shall notify the Owner and request an inspection of the duct cleaning methods and finished results. The Contractor shall not proceed in cleaning additional areas beyond the first until the owner has inspected these areas and accepted the Contractor's methods and results. Any unacceptable methods/practices or poor results shall be corrected.
- B. At the completion of the project the Contractor shall provide a cleaning report detailing all areas cleaned, and method/equipment used. The report shall also include at least 10 "before" and 10 "after" photographs showing un-cleaned vs. cleaned conditions.

3.05 COMMISSIONING

- A. The Products referenced in this section are to be commissioned per Division 01 Section 23 08 00. The Contractor has specific responsibilities for scheduling, coordination, startup, test, development, testing and documentation. At a minimum, the Contractor shall provide a documented and signed record to verify that all equipment and systems installed under this contract have been inspected and functionally tested to verify full compliance with the contract specifications. In many cases, this shall require the Contractor to create or otherwise provide procedures and checklists for approval by the Commissioning Consultant prior to the start of functional testing. Reference Division 01 Section 23 08 00 and coordinate all commissioning activities with the Commissioning Consultant.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Operation and Maintenance Manual.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00 and Division 01.
- B. Preliminary O&M: Submit preliminary review O&M manual for review.
- C. Final O&M: Submit Final O&M manuals per Division 01.

PART 2 - PRODUCTS

2.01 GENERAL

- A. General Contents: A maintenance manual shall be compiled containing maintenance and operating information and maintenance schedules for all project mechanical systems. See Division 01 for quantities, organization, format, and other requirements; meet additional requirements as specified herein.

2.02 SUBMITTAL DATA AND TECHNICAL O&M DATA

- A. Submittal Data:
 - 1. General: Provide a copy the submittal data (clearly identified and marked to suit each item). Note: The submittals are not retained by the Owner and a copy is therefore required in the O&M.
 - 2. Product Data: Manufacturer's technical product data, with manufacturer's model number, description of the equipment, equipment capacities, equipment options, electrical power voltage/phase, special features, and accessories. Label data sheets with same designation as used on contract documents. Provide for all items requiring maintenance and for items that may require replacement over a 30-year period or be revised due to an Owner building improvement.
 - 3. Shop Drawings: Provide copy of final shop drawings as approved for each area where shop drawings were required to be submitted.
- B. Technical O&M Data: Provide for each equipment or item requiring maintenance. Label O&M data to clearly indicate which equipment on the project it applies to (use same designation as used in the Contract Documents). Data to include:
 - 1. Manufacturer's operating and maintenance manuals and instructions.

2. Itemized list of maintenance activities and their scheduled frequency.
 3. Maintenance instructions for each maintenance activity.
 4. Manufacturer's parts list.
 5. Manufacturer's recommended lubricants.
 6. Size, quantity and type of filters required (as applicable).
 7. Size, quantity and type each belts unit requires (as applicable).
 8. Size, quantity and type of fuses (as applicable).
- C. Sources: Provide names, addresses, and phone numbers for local manufacturer's representative, service companies, and parts sources for mechanical system components.
- D. Start-Up Reports: Include copies of all equipment and system start-up reports.

2.03 MAINTENANCE SCHEDULES

- A. General: Provide Maintenance schedules with an itemized list of maintenance activities and their scheduled frequency (i.e., weekly, monthly, semi-annually, etc.) for item requiring maintenance.
- B. Special Maintenance: List any critical maintenance items or areas requiring special attention.
- C. Start-Up/Shut-Down: Provide normal start-up, operating, and shut-down procedures; emergency shut-down procedures; and (where applicable) seasonal shut-down procedures.

PART 3 - EXECUTION

NOT USED

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- D. Division 23 - Heating, Ventilation, and Air Conditioning (HVAC) Systems.
- E. Division 25 - Integrated Automation.

1.02 WORK INCLUDED

- A. General Mechanical System Requirements.
- B. Mechanical System Motors.
- C. Identification and Labeling.

1.03 DEFINITIONS

- A. Abbreviations and Terms: Where not defined elsewhere in the Contract Documents, shall be as defined in RS Means Illustrated Construction Dictionary, Fourth Addition and in the ASHRAE Handbook of Fundamentals, latest edition.
- B. "As required" means "as necessary to form a safe, neat, and complete working installation (or product), fulfilling all the requirements of the specifications and drawings and in compliance with all codes."
- C. "Concealed" means "hidden from view" as determined when areas are in their final finished condition, from the point of view of a person located in the finished area. Items located in areas above suspended ceilings, in plumbing chases, and in similar areas are considered "concealed." Items located in cabinet spaces (e.g. below sinks) are not considered concealed.
- D. "Coordinate" means "to accomplish the work with all others that are involved in the work by: directly discussing the work with them, arranging and participating in special meetings with them to discuss and plan the work being done by each, obtaining and completing any necessary forms and documentation required for the work to proceed, reaching agreement on how parts of the work performed by each trade will be installed relative to each other both in physical location and in time sequence, exchanging all necessary information so as to allow the work to be accomplished with a united effort in accordance with the project requirements".
- E. "Finished Areas" means "areas receiving a finish coat of paint on one or more wall surface."
- F. "Mechanical", where applied to the scope of work, includes all project plumbing systems, HVAC systems, and controls for these systems and all work covered by specification Divisions 23, and 25. Such work is shown on multiple drawings and is not limited to a particular set of sheets, or sheets prefaced with a particular letter.
- G. The term "related documents" (as used at the beginning of each specification section), and the Specification Divisions and Sections listed with it, is only an indication of some of

the specification sections which the work of that section may be strongly related to. Since all items of work relate to one another and require full coordination, all specification sections, as listed in the Table of Contents, shall be considered as being "related documents", and shall be considered (by this reference) in the same manner as if they had all been listed under the term "related documents" in each specification section.

- H. "Work included" (as used at the beginning of each specification section), and the items listed with it, is only an indication of some of the items specified in that Section and is in no way limiting the work of that Section. See complete drawings and specifications for all required work.
- I. "Verify" means "Contractor shall obtain, by methods independent of the project Architect/Engineer and Owner, the information noted and the information needed to properly perform the work". Where used as "verify existing" the reference is to all existing items related to the work (i.e. piping systems, duct systems, electrical power, controls, structural conditions, space available, building construction type, etc.); the "verify" definition shall include "Confirm by means independent of any existing field labeling and independent of the Architect/ Engineer and Owner what the existing piping (or duct) system contains, sizes, what the flow direction is, what normal pressures/temperatures are, what other systems and areas the piping (or duct) is interconnected to; what the existing control voltages/signal types are by direct measurement; what the existing electrical power voltages and phases are by direct measurement; and additional field verification and coordination to ensure that compatible products are provided, correct connections made, and all work performed to allow for fully functioning systems." "Means independent of existing field labeling" shall include methods such as: the use of exterior pressurized sources to pressurize piping system lines, use of flow tests with dyes, physical tracing of piping and all connections to, electronic detection methods, electronic/electric line tracing, electrical measurements, physical disassembling of system, excavation or uncovering of concealed systems, use of insertion cameras and similar efforts.
- J. "Substitution": As applied to equipment means "equipment that is different than the 'Basis of Design' equipment scheduled on the drawings (or otherwise indicated in the contract documents)".

1.04 GENERAL REQUIREMENTS

- A. Scope: Furnish all labor, materials, tools, equipment, and services for all mechanical work. This section applies to all Division 23, 25 specifications and to all project mechanical work. All mechanical equipment and devices furnished or installed under other Divisions of this specification (or by the Owner) which require connection to any mechanical system shall be connected under this division of the Specifications.
- B. General: All work shall comply with Division 00, General Conditions, Supplementary Conditions, Division 01, and all other provisions of the Contract Documents.
- C. Code:
 - 1. Compliance: All work shall be done in accordance with all applicable codes and ordinances. Throughout the Project Documents, items are shown or specified in excess of code requirements; in all such cases, the work shall be done so that code requirements are exceeded as indicated. Comply with code accessibility requirements.

2. Documentation: Maintain documentation of all permits and code inspections for the mechanical work; submit documentation showing systems have satisfactorily passed all AHJ inspections and requirements.
 3. Code Knowledge: Contractor and workers assigned to this project shall be familiar and knowledgeable of all applicable codes and ordinances. Code requirements are typically not repeated in the Contract Documents. By submitting a bid, the Contractor is acknowledging that the Contractor and workers to be utilized on this project have such knowledge.
 4. Proof of Code Compliance: Prior to final completion, satisfactory evidence shall be furnished to show that all work has been installed in accordance with all codes and that all inspections required have been successfully passed. Satisfactory evidence includes signed inspections by the local code authority, test lab results, qualified and witnessed field tests, and related acceptance certificates by local code authorities, and field notes by the Contractor as to when all inspections and tests occurred.
- D. Complete Systems: Furnish and install all materials, appurtenances, devices, and miscellaneous items not specifically mentioned herein or noted on the drawings, but which are necessary to make a complete working installation of all mechanical systems. Not all accessories or devices are shown or specified that are necessary to form complete and functional systems.
- E. Review and Coordination:
1. General: To eliminate all possible errors and interferences, thoroughly examine all the Drawings and Specifications before work is started, and consult and coordinate with each of the various trades regarding the work. Such coordination shall begin prior to any work starting, and continue throughout the project.
 2. Suppliers: Suppliers of products shall review the documents to confirm that their products are suitable for the application and that all manufacturers requirements and recommendations have been satisfactorily addressed in the Contract Documents. Where not addressed the supplier shall notify bidders and the Engineer prior to bidding to resolve any issue or include in their bid an adequate amount to resolve the issue.
- F. Conflicts and Discrepancies: Notify the Architect/Engineer of any discrepancies or conflicts before proceeding with any work or the purchasing of any materials for the area(s) of conflict until requesting and obtaining written instructions from the Architect/Engineer on how to proceed. Where conflicts occur, the most expensive and stringent requirement (as judged by the Architect/Engineer) shall prevail. Any work done after discovery of such discrepancies or conflicts and prior to obtaining the Architect/Engineer's instructions on how to proceed shall be done at the Contractor's expense.
- G. Drawings and Specifications: Drawings and specifications are complementary and what is called for in either is binding as if called for in both. The drawings are diagrammatic and show the general arrangement of the construction and therefore do not show all offsets, fittings and accessories which are required to form a complete and operating installation. Mechanical work is shown on multiple drawings and is not limited to a particular set of sheets, or sheets prefaced with a particular letter.

H. Offsets/Fittings:

1. Piping Systems: Include in bid all necessary fittings and offset to completely connect up all systems, maintain clear access paths to equipment, and comply with all project requirements. Offsets are required to route piping around building structural elements, roof slopes, mechanical systems, electrical systems, and numerous other items. Due to the schematic nature of the plans such offsets are typically not shown. Contractor is responsible to determine the quantity of offsets and fittings required, and the labor involved. No added payment or "extras" will be granted for the Contractor's failure to correctly estimate the number of offsets and fittings and labor required. Contractor is advised that equipment and fixture connections may require more than 20 elbows per plumbing fixture and coil per pipe line.
2. Duct Systems: Include in bid all necessary fittings, offsets, and transitions to completely connect all systems, maintain clear access paths, and comply with all project requirements. Offsets are required to route ducts around building structural elements, roof slopes, mechanical systems, electrical systems, and numerous other items. Due to the schematic nature of the plans such offsets are typically not shown. Contractor is responsible to determine the quantity of offsets and fittings required, and the labor involved. No added payments or "extras" will be granted for the Contractor's failure to correctly estimate number of offsets, fittings, transitions and labor required. Contractor is advised that transitions are required at connections to all equipment, to all air inlets/outlets, crossing of beam lines, at crossing with piping, and similar locations.

I. Design: The level of design presented in the documents represents the extent of the design being furnished to the Contractor; any additional design needed shall be provided by the Contractor. All design by the Contractor shall be performed by individuals skilled and experienced in such work, and where required by local code (or elsewhere in the documents) shall be performed by engineers licensed in the State where the project is located. Include in bid the costs of all such project design; including engineering, drafting, coordination, and all related activities and work. Such designs services are required for many building systems; including but not limited to ductwork at equipment, piping at fixtures and equipment, hanger/support systems, temporary duct/piping systems, mechanical offsets/adjustments to suit other system, seismic anchors, and for methods/means of accomplishing the work. Where design or performance criteria to be met is not stated (or is unclear), develop proposed criteria (based on code, similar projects, and related data) and submit the proposed criteria for review prior to performing full design work.

J. Special Tools: Furnish to the Owner one complete set of any and all special tools such as odd size wrenches, keys, etc. (allen wrenches are considered odd), which are necessary to gain access to, service, or adjust any piece of equipment installed under this contract. Each tool shall be marked or tagged to identify its use. Submit a written record listing the special tools provided, date, and signed by the Owner's representative receiving the tools.

K. Standards and References: Shall be latest edition unless a specific edition, year, or version is cited, or is enforced by the AHJ.

L. Warranties:

1. General: Products and workmanship shall be warranted to be free from all defects, capable of providing satisfactory system operation, and conforming to

the requirements of the Contract Documents. Include in the project bid all costs associated with project warranties to ensure that the warranty extends for the required period; possible project delays and failure by others to complete their work may cause the start of the warranty period to be delayed. The Contractor shall be responsible for increasing the warranty dates by corresponding amounts to provide the required warranty periods.

2. Basic Project Warranty: As described in the General Conditions, Supplementary Conditions, and Division 01. See individual specification sections for specific warranty requirements. Start date and duration are as indicated in General Conditions, Supplementary Conditions, and Division 01. Where not indicated otherwise, the basic project warranty shall start at project substantial completion and be for one year.
3. Special Warranties: See individual specification sections for special warranty requirements and extended warranty periods beyond the basic project warranty.

M. Permits and Fees:

1. Obtain and pay for all permits, licenses, fees and inspections as required by the Code and as specified herein (unless noted otherwise).
2. Pay all charges made by any utility company or municipality for material, labor or services incident to the connection of service (unless noted otherwise).

1.05 SUBSTITUTIONS

- A. General: See Division 00 and 01 for information and requirements regarding substitutions. Manufacturers not scheduled on the plans or listed as "Acceptable Manufacturers" require prior approval and shall submit a substitution request form (see Division 01 for requirements and limitations). See Paragraph 2.01 this specification section regarding "Acceptable Manufacturers".
- B. Redesign:
 1. The Contract Documents show design configurations based on particular manufacturers. Use of other manufacturers' products (i.e. substitutions) from what is shown (or specified) may require redesign of mechanical, plumbing, controls, fire protection, electrical, structural, and general building construction to accommodate the substitution.
 2. Review the installation requirements for substitutions and provide redesign of all affected construction. The redesign shall be equal or superior in all respects to the Architect/Engineer's design (as judged by the Architect/Engineer), including such aspects as equipment access, ease of maintenance, utility connection locations, unit electrical requirements, noise considerations, unit performance, and similar concerns.
 3. Redesign shall be done by the Contractor and shall meet the requirements and have the approval of the Architect/Engineer prior to beginning work. Apply for and obtain all permits and regulatory approvals.
- C. Construction Modifications: Provide all required construction modifications to accommodate the substituted products; this includes all mechanical, plumbing, controls,

fire protection, electrical, structural, and general building construction. Construction modification shall comply with code, specifications, and be equal to designed construction.

- D. Costs: Cost of redesign, construction costs, and all additional costs incurred to accommodate substituted equipment shall be borne by the Contractor.
- E. Submittals: In addition to other required submittals, submit shop drawings showing the redesign for substituted equipment; submittal shall include installation plans and sections, connecting services (i.e. ducts, piping, electrical) locations and routing, required service clearances, and related installation details. Submit data required by other disciplines to allow review of the impact of the substitution (i.e. weights, electrical).

1.06 QUALITY ASSURANCE

- A. Experience: All work shall be performed by individuals experienced and knowledgeable in the work they are performing, and experienced with the same type of systems and building type as this project. By virtue of submitting a bid, the Contractor is acknowledging that workers to be utilized on this project have such experience and knowledge. Upon request of the Engineer, submit resumes showing the work history, training, and types of projects worked on, for individuals assigned to this project.
- B. Code: Utilize workers experienced and knowledgeable with codes pertaining to their work; verify code compliance through-out the project.
- C. ASME: All pressure vessels, pressure vessel safety devices, and pressure vessel appurtenances shall comply with the standards of, and bear the stamp of ASME.
- D. Quality Assurance Checks: Prior to ordering products and making submittals, confirm the following for each:
 - 1. General: Product is suitable for the intended purpose and complies with the Contract Documents.
 - 2. Manufacturer: Product's manufacturer is listed as an acceptable manufacturer in the Contract Document's or a substitution request (where allowed) has been submitted and the manufacturer has been listed as acceptable.
 - 3. Electrical (for products requiring electrical power):
 - a. Product is for use with the voltage/phase as indicated on the electrical plans (or for the electrical circuit the item will be connected to).
 - b. Product's ampacity requirements (MCA) do not exceed that indicated on the electrical plans (or for the electrical circuit the item will be connected to).
 - c. Where product is a replacement for an existing product, and is to be re-connected to an existing circuit, the existing voltage/phase has been field verified and product matches voltage/phase available.
 - 4. Weight: Product's weight is no greater than that indicated.

5. Space Verification: Product will fit in the space available, and along the path available to install the item, will have adequate service clearances, and will not impede on any clearances required for other items in the space the item will be located.
 6. Installation: A suitable method for installing the product has been selected which meets the project schedule and other requirements.
 7. Anchorage/Support: The manufacturers recommended method of anchorage and support is consistent with the method indicated in the Contract Documents, and the item has provisions suitable for such anchorage/support.
 8. Lead Time: The product's fabrication, shipping, and delivery period meets the project schedule requirements.
 9. Substituted Equipment: Where equipment is not the basis of design confirm all requirements for substituted equipment have been met and shop drawings of construction revisions have been (or are being) prepared.
 10. Controls: Item is compatible with the controls it will be connected to and has been coordinated with the firm providing the project control work to provide the specified (or required) sequence of operation.
 11. Listing: Item is Listed when required to be as such. And if the item is to be installed as part of a Listed system or assembly, it is compliant with the Listing of the overall system or assembly.
 12. Existing Buildings/Systems: Product size, weight, connecting services (i.e. electrical, controls, power, plumbing, etc.) are configured and suitable for existing items they connect to or interface with.
- E. Check-Out: The Contractor shall be responsible to verify that proper installation and proper connections have been provided for all mechanical work. Contractor shall provide installation checkout, start-up services, and perform a thorough check of all mechanical systems to verify proper installation and operation. Contractor shall operate all items multiple times under varying conditions to confirm proper operation. Contractor shall submit a checklist listing all equipment, fixtures, and similar items furnished on this project, with a date and initials indicating when the item was checked, a list of what was checked, and by whom. Such check shall, as a minimum utilize documents provided by the equipment manufacturer. Such a check-out is in addition to any commissioning activities specified (unless noted otherwise).

1.07 SUBMITTALS

A. General:

1. See Division 00 and 01 for submittal requirements.
2. By making a submittal (of shop drawings or product data) the Contractor represents that they have reviewed them for compliance with the Contract Documents, including detailed connection and installation features and requirements, and that the submitted item is their proposed method of compliance with the Contract Documents.

3. Perform no portion of the work for which the Contract Documents require a submittal until the respective submittal has been made, the review completed by the Architect/Engineer, and all issues resolved.
 4. The Owner and Architect/Engineer are depending on the submittal process as a final review and confirmation of materials and various aspects of the work, and may make changes in the project due to information contained in the submittals and with the understanding that the opportunity to make changes exist until submittals are made and the review is completed. The Contractor is responsible for added costs which may be incurred if work is performed which limits the Owner the opportunity to make such changes (e.g. work done prior to a submittal being made or the submittal review being completed).
 5. Submittals shall be logically organized, neat and legible. Submittals to include:
 - a. Name of project.
 - b. Owner's name.
 - c. Specification section reference and paragraph (or drawing number or detail) submittal is for.
 - d. Contractor name and contact information.
 - e. Subcontractor name and contact information.
 - f. Date of submittal.
- B. Quality Assurance: By submitting an item for review, the Contractor is claiming that all "Quality Assurance Checks" (see paragraph 1.06 this specification Section) have been performed and satisfactorily passed and no further comment from the submittal reviewer is required for the "Quality Assurance Checks".
- C. Variations: Only variations that are specifically identified as described herein will be considered. Provide with the submittal (in addition to other information required): description of the proposed variation, entity who is proposing the variation, why the variation is being proposed, any cost changes associated with the variation, and any other pertinent data to allow for review. Failure to submit information on the variation as described will result in the submittal review being conducted without considering the variation.
- D. Product Submittals - Information Required:
1. Manufacturer's professionally developed documents, containing product description, model number, and illustrations. Mark clearly to identify pertinent information and exact model and configuration being submitted.
 2. List of accessories and options provided with product.
 3. Product dimensions and clearances required.
 4. Product weight.

5. Submittal identified with product name and symbol (as shown on the drawings or written in the specifications) and specification Section and paragraph reference.
 6. Performance capacity and characteristics showing compliance with the Contract Documents.
 7. Manufacturer's and local manufacturer's representative names, addresses, and phone numbers.
 8. For equipment requiring piping or duct connections:
 - a. Type of connections required.
 - b. Size and locations of connections.
 9. For electrically operated equipment:
 - a. Number and locations of electrical service connections required.
 - b. Voltage required.
 - c. Fuse or circuit breaker protection requirements.
 - d. Motor starter requirements; if motor starter is furnished with the equipment, submit product information on motor starter.
 10. For equipment requiring control connections:
 - a. Type of control signals required.
 - b. Control communication protocol.
 - c. Information on control devices furnished with equipment.
 - d. Location of control connections.
 11. Manufacturer's installation instructions.
 12. See each specification Section for additional submittal requirements.
 13. Edited Content: Submittals shall indicate the equipment and options that are to be provided. Copies of an unedited catalog will be rejected. Pages/items that are not applicable shall be deleted prior to submittal to the Engineer.
- E. Shop Drawing Submittals:
1. Shop drawings shall be professionally drafted using AutoCAD, Revit, or an equivalent compatible program (hand sketches are not acceptable). Shop drawings shall be independently developed by the Contractor and not be a copy of the Contract Drawings.
 2. Submit electronic files in original drafting format (i.e. *.dwg) and pdf format with as-built documentation.

3. Provide shop drawings for the following systems:
 - a. HVAC control systems.
 - b. For any parts of any system which are to be installed differently than as shown on the drawings.
 - c. Construction revisions to accommodate Substituted Equipment.
 - d. Other areas/work as noted in the Contract Documents.
 - e. For those systems requiring shop drawings, reference system's specification Section for additional requirements.
- F. Re-Submittals: If submittals are marked 'Rejected' or 'Revise and Resubmit', the Contractor shall revise the submittal to satisfy the comments or conform to project requirements, and submit to the Engineer for review. Only those items that were rejected or required a resubmittal will be reviewed by the Engineer; All other items will not be reviewed. All re-submittals shall be at least one of the following:
 1. Provide a 'Re-Submittal Summary Sheet' which indicates how each comment was addressed (it is acceptable to add the responses to a copy of the original submittal review comments).
 2. Cloud (or otherwise clearly identify) the revised portions to indicate what is different from the original submittal.

1.08 RECORD DOCUMENTS

- A. Field Record Drawings: Maintain a set of full size contract plans at the project site upon which all changes from the as-bid plans are noted. Plans shall be maintained clean, dry and legible; with information recorded concurrent with construction progress. These plans shall also include actual locations (with dimensions) of all underground and concealed mechanical systems. Connection points to outside utilities shall be located by field measurements and so noted on these record drawings. All addenda, change order, field orders, design clarifications, request for information, and all other clarifications and revisions to the plans shall also be made a part of these record drawings. Plans shall be available for weekly review by the Architect/Engineer. Label drawing "As-Built" with date, name of Contractor, and name of individual overseeing the work.
- B. Final Field Record Drawings Submittal: Deliver to the Architect/Engineer the original Field Record drawings and one full size copy.

1.09 PRODUCT HANDLING, PROTECTION AND MAINTENANCE

- A. Protection:
 1. Protect all products from contamination, becoming unclean, and from damage of any kind and whatever cause; when being handled, in storage, and while installed, until final project acceptance.
 2. Completely cover fixtures, motors, control panels, equipment, and similar items to protect from becoming unclean and damage of any kind.

3. Protect premises and work of other trades from damage due to Mechanical work.
- B. Openings: Cap all openings in pipe, ductwork and equipment to protect against entry of foreign matter until all work that could cause unclean conditions or damage is complete (including work that has dust or fumes associated with it). Caps shall be of sufficient strength and seal integrity to prevent entry of water or fumes for the most extreme conditions they may be exposed to (i.e. high velocity water spray, high winds, concrete splash, etc.)
- C. Storage: Provide properly conditioned and sheltered storage facilities for products to prevent damage of any kind and to maintain new condition. Provide adequate venting arrangements to avoid condensation damage.
- D. Operation and Maintenance:
 1. General: Inspect products periodically to confirm conditions and maintenance needs. Keep records of inspections and (upon request) forward to the Architect/Engineer prior to project final acceptance. Operation and Maintenance shall be in accordance with manufacturer's written procedures and recognized best maintenance practices. Keep records of maintenance and (upon request) forward to the Architect/Engineer prior to project final acceptance.
 2. Stored Products: Provide maintenance (i.e. equipment rotation, lubrication, flush, cleaning, etc.) and inspection on products while stored to maintain new condition.
 3. Installed Products: Provide maintenance and inspection of products and operate mechanical systems until substantial completion or specified Owner Instruction has been provided (whichever is later). Maintenance shall include all labor and materials and all manufacturers' recommended maintenance (i.e. strainer cleaning, filter changes, bearing lubrication, belt tensioning, etc.). In addition to scheduled maintenance, review all equipment periodically to allow detection of improper operation or any special maintenance needs; review shall be consistent with best practices for the product but in no case less than a site visit every two weeks. Document all maintenance activities.
- E. Damaged Products: Damaged products shall be replaced with new. Where damage is limited to paint (or similar finish), the product may remain if the finish is restored to a new condition (as judged by the Architect/Engineer).

1.10 JOB CONDITIONS

- A. Special Requirements:
 1. Maintain emergency and service entrance usable to pedestrian and vehicle traffic at all times. Where trenches are cut, provide adequate bridging for traffic.
 2. Coordinate startup and shutdown of all mechanical systems and utilities with related trades and the Owner's representative.
 3. Coordinate all construction activities with the Owner's Representative and cooperate fully so as to minimize conflicts and to facilitate Owner usage of the premises during construction.

4. Provide temporary services to occupied areas to accommodate Owner's use during construction. All temporary work shall comply with same specifications as for new work and be of same quality.
- B. Downtime Restrictions:
1. Contractor shall notify the Owner at least 72 hours in advance of any intended shut-down of any building services or systems and obtain Owner approval prior to proceeding.
 2. Electrical power to the building shall not be interrupted at any one time for more than 15 minutes.
- C. Schedule of Work: Arrange work to comply with schedule of construction, and so as not to violate any downtime restrictions, and to accommodate the Owner's scheduled use of the premises during construction.

1.11 ENGINEER FIELD REVIEWS AND TEST WITNESSING

- A. General: Arrange construction schedule and notifications to the Engineer to accommodate Engineer's schedule and the possibility of review times occurring up to 14 days after notification, and for the possible failure to satisfactorily pass Engineer's reviews requiring revisions and re-reviews.
- B. Notification: Notify Engineer at least 7 days in advance of readiness for reviews; arrange mutually agreed upon times for the reviews to occur.
- C. Access: Provide ladders, any special tools and safety equipment to allow Engineer's access to areas and equipment. Remove and reinstall ceiling tiles, access panels, and similar items where requested to allow for reviews.
- D. Review of Systems with Equipment:
1. Prior to Engineer's review, system's equipment shall have received specified start-up and be substantiated by a written report.
 2. Prior to Engineer's review, systems shall have been operating properly for at least five consecutive days prior to the scheduled review date.
 3. Personnel shall be present to operate the system's equipment and controls, and to vary system settings as directed by the Engineer to allow for a review of operation over a range of settings.
- E. Re-Review Fees: The project budget allows for one review by the Engineer for specified reviews and witnessing. See Division 00 and 01 for compensation to the Engineer for required re-reviews.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. General: Any reference in the Specifications or on the Drawings to any article, device, product, material, fixture, form or type of construction by manufacturer, name, make,

model number, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The manufacturers listed as Acceptable Manufacturers may bid the project for the items indicated without submitting a substitution request; however that does not relieve the products from having to comply with the Contract Documents.

- B. Substitutions: Products by manufacturers listed as "Acceptable Manufacturers" (other than those listed as the "Basis of Design") are considered substitutions and shall comply with the requirements for substitutions. See Paragraph titled "Substitutions" in Part 1 of this specification section.
- C. Considerations: In reviewing a manufacturer for acceptance, factors considered (as compared to the specified item) include: engineering data showing item's capacity, performance, proper local representation of manufacturer, likelihood of manufacturer's future local support of product, service availability, previous installations, previous use by Owner/Engineer/Architect, product quality, availability/quality of maintenance and operation data, electrical requirements, capacity/performance, acoustics, physical dimensions, weight, items geometry and access requirements, utility needs, and similar concerns.
- D. Limitations of the Term "Acceptable Manufacturer": The listing of a manufacturer as an Acceptable Manufacturer does not necessarily mean that the products of that manufacturer are equal to those specified. The listing is only an indication of those manufacturers which have represented themselves as being capable of manufacturing, or have in the past manufactured, items equal to those specified. The burden to review products to confirm equivalency with the specified products is on the Contractor. The Architect/Engineer shall be the final judge as to whether an item is equal to that specified.
- E. Quality: Products provided by Acceptable Manufacturers shall be equal to or superior to the specified manufacturer's item in function, appearance, and quality, and shall fulfill all requirements of the Contract Documents. The Architect/Engineer shall be the judge as to whether an item meets these requirements or not.
- F. Manufacturer: To be considered as being made by a particular manufacturer, the product must be made directly by the manufacturer and have the manufacturer's name (or nameplate with name) affixed to the product (or on the product container where direct labeling is not possible). Example: manufacture "A" is listed as an acceptable manufacture; manufacturer "B" is not listed as an acceptable manufacturer; manufacturer "A" owns "B"; products from "B" do not qualify as being made by an acceptable manufacturer by virtue of ownership.

2.02 PRODUCTS - GENERAL

- A. Standard Products: Products shall be standard products of a manufacturer regularly engaged in the manufacture of such products. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two year use shall include applications of equipment and materials under similar circumstances and of similar size. The two year's experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Except that equipment changes made solely to satisfy code requirements, to improve unit efficiency, or to comply with unique project requirements are not required to have two year prior operation.
- B. Latest Design: Products shall be the latest design and version available from the manufacturer, including software. Discontinued products shall not be used.

- C. Service Support: Qualified permanent service organizations for support of the equipment shall be located reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- D. Manufacturer's Nameplate: Equipment shall have a manufacturer's nameplate bearing the manufacturer's name, address, model number, serial number, and additional information as required by code. Nameplate shall be securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable. Nameplate shall be of durable construction, easily read, with lettering minimum size 12 font.
- E. Compatibility: All components and materials used shall be compatible to the conditions and materials the items will be exposed to. All items exposed to the weather shall be galvanized, or be of stainless steel or similar corrosion resistant material.
- F. Sizes: Sizes indicated for products manufactured to standardized sizes (e.g. pipe, pipe fittings, valves, material gauges, etc.) are minimums. During bidding confirm that the sizes are available and meet project requirements. Where indicated sizes are not available provide the next larger available size; confirm this larger size will suit the construction and meet Contract Document requirements prior to ordering. Such size revisions are subject to Engineer's review; indicate size revisions on the product submittal and why the size is being revised.
- G. Non-Specified Items: Materials shown on the drawings but not specified shall be provided as shown and as required to suit the application illustrated and intended and shall be of commercial quality, consistent with the quality of similar type items provided on the project. Not all items shown on the drawings necessarily have a corresponding specification; such items shall be provided per this paragraph and so as to provide complete, finished, fully functioning mechanical systems.
- H. Weights: Do not exceed the weights shown unless added structural supports are provided. Such supports shall meet the requirements of the project Structural Engineer. The Contractor shall bear all costs for all redesign and added supports to accommodate heavier equipment. The Contractor shall reimburse the Engineer for all time associated with all review and analyses regarding the use of equipment heavier than that indicated.
- I. Temperature/Pressure Rating: All materials and components furnished shall be suitable for the temperature and pressures they will be exposed to. Contractor shall consider possible operating modes to ensure proper material ratings.
- J. Standardization: All products of the same type shall be by the same manufacturer and have the same characteristics and features to allow for Owner's standardization.
- K. Model Numbers: Any reference to a manufacturer's "model number" is a reference to a manufacturer's series number or type of product, and is not a complete "model number" in having all the necessary numbers/letters to convey all of the features, accessories, and options that are required. These series numbers are only meant to convey a type of product that may meet the project requirements. Where conflicts or discrepancies occur regarding a listed manufacturer's series or "model" number and specified capacities or features, the more stringent and expensive shall prevail.
- L. Application and Suitability: Products shall be designed and intended for: institutional application, for the use indicated, and be suitable for the operating conditions they will be exposed to. Firms supplying the products shall review the documents and related site

and environmental data to confirm compliance. By making product submittals and using products they are being represented as appropriate for the project and application shown.

2.03 ELECTRICAL

- A. General: All electrical devices, wiring, products, and work shall comply with the Division 26 specifications and code. See drawings for building occupancy type, types of construction, and areas which may require special wiring methods or other electrical work.
- B. Equipment: All equipment requiring power shall be factory wired to an equipment mounted junction box (or an accessible compartment with power terminals or electrical device) arranged to allow for connection of electrical power.
- C. Overcurrent protection: Circuit breakers, circuit breaker disconnects, fuses, and other current limiting devices indicated to be provided, shall be rated to suit the maximum overcurrent rating of the item served, and have other ratings, as required by code. Circuit breakers for HVAC and refrigeration unit equipment shall be UL listed by HACR type.
- D. Short Circuit Current Rating (SCCR): All equipment (or components) requiring the use of electrical power shall have a SCCR value to comply with code. The minimum rating shall be 65,000 Amps RMS Symmetrical unless a lower value is indicated on the plans or allowed by code. Where the Contractor wishes to utilize equipment having a lower rating, the Contractor shall be responsible to provide calculations substantiating that a lower SCCR is acceptable (and complies with code), or make revisions to the electrical system to accommodate the proposed equipment (or components).
- E. Product Certification (Listing): Products which require connection to electrical power shall be certified (i.e. listed) by a Nationally Recognized Testing Laboratory (NRTL) and be labeled (in a conspicuous place) with such certification (or certification mark). Certification shall comply with code, OSHA Standards, and Authority Having Jurisdiction (AHJ) requirements. NRTL's shall be recognized as such by OSHA and the AHJ. Certification shall be for the complete assembly (approval of individual components is not acceptable). Field evaluations to obtain certification shall be performed by accredited product testing laboratories acceptable to the AHJ and Engineer, be performed in accordance with code, NFPA 791, recognized practices, and be labeled to identify the certification. Certification is not required where the AHJ does not require it.

2.04 MOTORS

- A. General: Where a piece of equipment specified includes an electric motor, the motor shall be factory installed and mounted. Motor starters and motor electrical disconnect switches shall be provided by the Contractor doing the work of the Section where the item was specified, unless specifically shown to be provided by Division 26 (or another Division). Wiring from the motor to motor starters and to electrical disconnects shall be by the Contractor doing the work of the Section where the item was specified, unless specifically shown to be provided by Division 26.
- B. Acceptable Manufacturers: General Electric, TECO-Westinghouse, Reliance, Gould, Century, Baldor, U.S. Motors, Marathon, and acceptable manufacturers for the equipment (see individual specification sections).
- C. Type: Motor type shall comply with code and applicable standard requirements and be configured to suit the application. Motors located indoors shall be open frame, drip-proof

type, unless indicated otherwise. Motors located outdoors exposed to weather shall have corrosion resistant finish and shall be totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) type, unless indicated otherwise.

- D. Listing: All motors shall be UL listed.
- E. Efficiency: Motor efficiencies shall comply with code. Fractional horsepower motors shall be the electronically commutated (EC) type with speed control where noted and where non-EC motors are not available which comply with code efficiency requirements. Motor power factor shall comply with code, local utility requirements, and as indicated. Provide added power factor correction devices as necessary to comply.
- F. Sizing: Motors shall not be smaller than indicated and of adequate size to start and drive the respective equipment when handling the quantities specified without exceeding the nameplate full load current at the conditions indicated and for the expected operating conditions. If it becomes evident that a motor furnished is too small to meet these requirements as a result of the Contractor using substituted equipment or having revised the system arrangement, the Contractor shall replace it with a motor of adequate size at no additional cost to the Owner. Contractor shall also arrange with the Electrical Contractor to increase the size of the wiring, motor starter and other accessories as required to serve the larger motor at no additional cost to the Owner.
- G. Service Factor: Minimum 1.15.
- H. Variable Frequency Drive (VFD) Applications: Motors used with Variable Frequency Drives (VFD's) shall be rated for such use per IEEE standards and have shaft grounding protection.
- I. EC Motors (ECM):
 - 1. General: Electronically commutated type with integral inverter to convert AC power (of voltage/phase indicated) to DC power, and solid state circuitry to vary output power and speed of motor. Motor shall have permanently lubricated bearings with an L10 life of 100,000 hours at expected operating conditions. Motor shall have rotor position and rotation detection as required for operation.
 - 2. Speed Range: Motor speed shall be controllable down to 25% of full speed.
 - 3. Manual Speed Control: Provide with manual speed adjustment dial for motor speed control. Dial shall be motor mounted unless indicated otherwise, operable by a screwdriver or by hand. Motor mounted controls shall be factory wired. Remote mount dials shall be hand operable (i.e. no tools required), shall be for mounting on a standard 2 x 4 electrical junction box, and be able to be located up to 100 feet remote from the motor. Motor control wiring for remote mount dials shall be factory wired from the motor to an equipment mounted junction box (with field supplied wiring from this J-box to the remote dial).
 - 4. EMCS Control: Motor speed shall be adjustable via a remote 0-10V input signal (unless noted otherwise) from the building EMCS. Control wiring shall be factory wired from the motor to an equipment mounted junction box. EMCS control is not required where not indicated to be provided or where not utilized as part of the control sequence.

2.05 IDENTIFICATION AND LABELS

- A. General: All piping, valves, and mechanical equipment shall be labeled. Labels in concealed accessible spaces shall be reviewed and verified by Architect/Engineer prior to being concealed.
- B. Piping:
1. Type: Self-sticking colored identification markers, lettered to identify the pipe contents, and banded at each end with arrow tape indicating the direction of flow. Markers shall be similar and equal to Brady "System 1" and Seton "Opti-Code" markers. Spray painted stencil labeling is not acceptable. Some labels may be special order.
 2. Identification Colors: Comply with ASME A13.1, and as follows:

<u>Conveyed Material/System</u>	<u>Background</u>	<u>Letters</u>
Hydronic Systems	Yellow	Black
 3. Lettering: Lettering shall identify the material conveyed in each pipe and shall match the designation used on the plans, but without abbreviations. Systems which have supply and return piping shall have piping labeled as such (i.e. heating water return, heating water supply, etc.). Systems that have different pressures shall be labeled to indicate such (i.e. Steam-Low Pressure, Steam-Medium Pressure, Natural Gas-Low Pressure, Natural Gas-Medium Pressure, etc.).
 4. Size: Size of letters and color field shall comply with ASME A13.1, repeated here for convenience:

<u>Outside Diameter of Pipe or Covering</u>	<u>Length of Color Field</u>	<u>Size of Letters</u>
3/4 to 1-1/4 Inches	8 Inches	1/2 Inches
1-1/2 to 2 Inches	8 Inches	3/4 Inches
2-1/2 to 6 Inches	12 Inches	1-1/4 Inches
8 to 10 Inches	24 Inches	2-1/2 Inches
Over 10 Inches	32 Inches	3-1/2 Inches
 5. Applications: Install on all exposed piping adjacent to each shut-off valve, at branches to indicate changes of direction, where pipes pass through walls and floors, on 20 foot centers or at least one in each room on each pipe. Markers shall be installed on all concealed accessible piping (i.e., piping above suspended ceilings, behind access doors, in accessible chases, etc.) near the point of access. For piping above suspended ceilings, markers shall be installed the same as if the piping was exposed (i.e., same as if the suspended ceiling was not in place). Markers shall be installed so as to be easily read by a person standing on the floor. Provide additional flow arrows at each pipe connection at valves having more than 2 ports (i.e. 3-way control valves).
 6. Other Requirements: See other specification Sections for additional requirements.
- C. Valves:
1. Labels: Laminated plastic or phenolic material, at least 1/16-inch thick, with black surface layer and white (unless other color indicated) sub-layer for letter engraving to expose sub-layer. Labels shall not be less than 3" x 1" in size.

Label shall be pre-drilled at one end for attachment to valve. Attach to valve with No. 6 polished nickel-steel jack chain of sufficient length to allow label to hang free.

2. Lettering: Engrave label with valve size, name of system served (cold water, heating water supply, chilled water supply, etc.) and purpose of valve. Lettering size 3/16-inch, except where needed to be smaller to fit label size.
3. Application: Labels shall be installed on all valves except valves at hydronic system coils and equipment where the valve purpose is readily obvious.

D. Equipment:

1. Labels: Laminated plastic (or phenolic) material, 1/16-inch thick, with black surface layer and white (unless other color indicated) sub-layer, with engraving through to expose white sub-layer. Minimum 2-inch high (unless indicated otherwise or required due to equipment size) with length to contain required lettering. Label shall be pre-drilled and be mechanically fastened to the equipment. Prior to making labels, submit a list of all proposed labels.
2. Lettering: All caps, engraved on label, with equipment designation (same designation as used on Contract Drawings; e.g. HVAC-101, EF-22, CP-1A). Air handling equipment (i.e. VAV terminal units, fans, etc.) labels shall include the room names and numbers or area of building served (use final installed room designations). Where systems serve portions of the building (i.e. wings or floors), include on label the area served. Lettering shall be in multiple rows, with equipment label on top row. Equipment lettering to be 5/8-inch high; area served lettering to be 3/8-inch high (except that smaller lettering may be used if necessary to fit label size).
3. Application: All scheduled mechanical equipment shall be labeled. The label shall be located on a side of the equipment so as to be easily read, with the marking visible to a person standing at the access level near the equipment (assuming any necessary access to a concealed unit has been made).

PART 3 - EXECUTION

3.01 GENERAL

- A. Workmanship: Furnish and install products to provide complete and functioning systems with a neat and finished appearance. If, in the judgment of the Architect/Engineer, any portion of the work has not been installed in accordance with the Contract Documents and in a neat workmanlike manner, or has been left in a rough, unfinished manner, the Contractor shall be required to revise the work so that it complies with the Contract Documents, at no increase in cost to the Owner.
- B. Coordination: Coordinate the work with all trades that may be affected by the work to avoid conflicts, allow proper maintenance access, provide required clearances, and to allow for an organized and efficient installation of all systems.
- C. Submittals: Perform no portion of the work for which the Contract Documents require a submittal until the respective submittal has been made, the review completed by the Architect/Engineer, and all issues resolved.

- D. Examination and Preparation: Examine installation conditions and verify they are proper and ready for the work to proceed. Verify compatibility of materials in contact with other materials, and suitability for conditions they will be exposed to. Do not proceed with the work until unsatisfactory conditions have been corrected. Prepare area to accept the work and prepare products for the installation.
- E. Field Conditions: Check field conditions and verify all measurements and relationships indicated on the drawings before proceeding with any work. In verifying existing conditions, the Contractor shall verify by direct physical inspection, complete tracing out of systems, by applying test pressures, by excavation and inspection, use of pipeline cameras, and other suitable absolute certain methods to confirm the actual physical conditions that exist.
- G. Openings and Cutting and Patching in Existing Construction:
 - 1. Openings--General: Provide all openings and cutting as needed to accommodate all work. Provide patching to restore all damaged and disturbed areas to pre-construction conditions (or better). The Contractor or subcontractor requiring the opening shall be responsible for making that opening. The opening shall be made by skilled labor experienced in providing openings in the material being penetrated.
 - 2. Areas To Be Cut and Patched: Wherever floors, walls, ceilings, plates, firestops and framing members are cut, these openings shall be substantially reinforced and sealed so as to maintain the strength and sealing ability of the element equal to that as if it had not been cut. All reinforcement/sealing shall satisfy the Architect/Engineer and comply with the governing codes. Such cut areas shall be patched and restored to a finished condition, equal to adjacent final finished areas that have not been cut.
 - 3. Cutting of Structural Features: Make no cuts or alterations to any structural framing members without explicit consent of the Engineer, and then only under his direction. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. All required cutting to install material shall be accomplished with the use of saw cutting equipment.
 - 4. Patching Materials: Patching shall be with materials of like kind and quality of the adjoining surface by skilled labor experienced in that particular trade.
- H. Cleaning: Clean all products (whether exposed to view or not) of all construction debris, and other materials; grease and oil spots shall be removed with appropriate cleaning agents and surfaces carefully wiped clean. Where cleaning cannot restore items to new conditions, the item shall be replaced with new.

3.02 INSTALLATION

- A. General: Work shall be in accordance with manufacturer's written installation instructions, code, applicable standards, and best construction practices.
- B. Space Verification: Prior to ordering materials verify that adequate space exists to accept the products, along the installation path, and to allow for proper maintenance access. Select products that will fit the space available; some optional materials (i.e. valve types, fitting types, substitutes manufacturer's etc.) may not be suitable. Verification shall be by direct field measurement of the actual space available and use of manufacturer's final

submittal dimensions. Where the project involves new construction and long lead items and a time schedule not allowing for such direct field measurements, confirm in writing with all trades associated with building the space that adequate room is available. Review maintenance and service access space required and confirm requirements will be met. No submittals shall be made until such space verification work has been performed, and confirmed that adequate space is available. By virtue of making a submittal that Contractor affirms he has completed this verification.

C. Installation Locations:

1. General: Unless dimensioned locations for items are shown, select the precise location of the item in accordance with the Contract Documents, coordinated with other trades and item connection locations, and subject to the Architect/Engineer's review. No allowances will be granted for failure to obtain the Architect/Engineer's review, failure to coordinate the work, and failure to comply with Contract Document requirements.
2. Manually Operated Components: Valves, damper operators, on/off switches, keypads, controls, and other devices which are manually adjustable or operated shall be located so as to be easily accessible by a person standing on the floor adjacent to the item. Any such items which are not in the open shall be made accessible through access doors in the building construction. See individual specification sections for additional requirements.
3. Monitoring Components: Gauges, thermometers, instrumentation, and other components which display visual information (i.e. operating conditions, alarms, etc.), shall be located and oriented so as to be easily read by a person standing on the floor. Provide necessary brackets, hangers, remote read devices and accessories as needed. Equipment control panels and graphic displays furnished with equipment (or integral to equipment) shall be located to be easily accessible by a person standing on the floor adjacent to the equipment, and be located between 4-feet and 6-feet above the finished floor.
4. Installation Issues: If circumstances at a particular location make the accessible installation of an item difficult or inconvenient, the situation shall be discussed with the Architect/Engineer before installing the item in a location that will result in poor access.
5. ADA Accessibility: Locate items which are required to be ADA accessible in accordance with code (including but not limited to IBC, ICC A117.1 and local amendments) for accessibility; verify accessibility requirements with the AHJ.

D. Replacement and Maintenance: Install mechanical equipment to permit easy access for normal maintenance, and so that parts requiring periodic replacement or maintenance (e.g. coils, heat exchanger bundles, sheaves, filters, bearings, etc.) can be removed. Relocate items which interfere with access or revise item installation location, orientation, or means of access.

E. Building Access Doors: Provide access doors where indicated and where needed to provide access to valves, drains, duct access doors, and similar items requiring service or access that would otherwise be inaccessible. Consult architectural drawings and coordinate location and installation of access doors with trades which are affected by the installation. Access doors are typically not shown on the drawings. The Contractor shall review all construction details and types and locations of items requiring access to determine quantity and sizes of access doors required.

- F. Rotating Parts: Belts, pulleys, couplings, projecting setscrews, keys and other rotating parts which may pose a danger to personnel shall be fully enclosed or guarded in accordance with Code, and so as not to present a safety hazard.
- G. Equipment Pads:
 - 1. Outdoors At Grade:
 - a. General: All ground mounted mechanical equipment shall be installed on a concrete pad (unless indicated otherwise). Pad shall be minimum 4-inch thick, minimum 4" wider than the equipment all around. Set pad on minimum 6-inch gravel base, compacted to 95% density. Concrete shall be same as used for building footings (unless noted otherwise) and be placed in accordance with ACI standards.
 - b. Where the largest dimension for any pad exceeds 4 feet or the equipment exceeds 300 lbs, provide pad with welded wire fabric (6-inch x 6-inch, No. 6), centered in pad.
 - c. Where the largest dimension for the pad exceeds 6 feet or the equipment weight exceeds 400 lbs, see structural drawings.
 - d. Freeze Protection: Where project location is subject to freezing water below the bottom of the pad depth, provide thickened perimeter edge to frost depth (unless written direction from a structural engineer or the soils report does not require such depth).
- H. Dissimilar Metals: Provide separations between all dissimilar metals. Where not specified in another way, use 10 mil plastic tape wrapped at point of contact or plastic centering inserts.
- I. Electrical Offsets: Provide offsets around all electrical panels (and similar electrical equipment) to maintain space clear above and below electrical panels to structure, and clearance of 3.5 feet directly in front of panel, except where indicated otherwise or required by code to be more. Such required offsets are typically not shown on the plans but are to be provided per this paragraph. Include in bid offsets for all systems near electrical panels.
- J. Piping Through Framing: Piping through framing shall be installed in the approximate center of the member. Where located such that nails or screws are likely to damage the pipe, a steel plate at least 1/16-inch thick shall be installed to provide protection. At metal framing, wrap piping to prevent contact of dissimilar metals. At metal and wood framing, provide plastic pipe insulators at piping penetrations through framing nearest each equipment connection and on at least 32-inch centers.
- K. Safety Protection: All ductwork, piping and related items installed by this Contractor that present a safety hazard (i.e., items installed at/near head height, items projecting into maintenance access paths, etc.) shall be covered (at hazardous area) with 3/4" thick elastomeric insulation and reflective red/white self-sticking safety tape. All sharp corners on supports and other installed items shall be ground smooth.
- L. Equipment Access: Access to equipment is of utmost importance. Contractor shall apply extra attention to the location of pipe and duct routings and in coordinating all work so

that equipment access and a clear maintenance pathway to equipment is maintained. Poor maintenance access will not be accepted.

- M. Pressure Tests: Maintain documentation of all pressure (and leakage) tests performed on systems and submit with project closeout documents. Records shall contain (as a minimum): date of test, system name, description portion of system being tested, method of test, initial and final test pressures (or of measured leakage rates, as applicable), indication of test pass or fail, name and signature of individual performing (or documenting) the test, initials of independent witness of test.

3.04 PENETRATION PROTECTION

- A. Exterior and Watertight Penetrations: Where any work pierces the building exterior (or construction intended to be watertight) the penetration shall be made watertight and weatherproof. Provide all necessary products (e.g. caulking, flashing, screens, gaskets, backing materials, siding, roofing, trim, etc.). Where not detailed or indicated how to install submit shop drawings of the proposed methods. Flashing arrangements shall be per SMACNA Architectural Sheet Metal Manual unless noted otherwise. Caulking alone is not an acceptable means of sealing penetrations.
- B. Equipment: Equipment or products located outdoors shall be watertight (except for provisions designed to intentionally accept water and having drain provisions) and shall be designed and intended by the manufacturer to be used outdoors at the project location. Where any work pierces the unit casing exposed to the outdoors the penetration shall be made watertight and weatherproof; provide all necessary products (e.g. caulking, flashing, gaskets, backing materials, etc.).

3.05 START-UP

- A. General: Provide inspections, start-up and operational checks of all mechanical systems and equipment. Maintain documentation of all start-up work and submit with project closeout documents. See individual specification Sections for additional requirements.
- B. Personnel: Inspection and start-up services shall be done by individuals trained in the operation, and knowledgeable with, the systems being started-up. Equipment start-up shall be by the manufacturer's authorized service representative where indicated (see individual specification Sections).
- C. Scheduling and Agenda: Submit a proposed detailed start-up schedule with proposed dates and times at least 30 days prior to the earliest proposed system start-up. Revise dates and times as mutually agreed upon with trades involved, and witnesses, before submitting a final start-up schedule.
- D. Witnessing: Start-up may be witnessed by the Engineer and Owner's representative (at their option). Notify the Engineer and Owner 7 days prior to the proposed start-up time.

3.06 OWNER INSTRUCTION

- A. General: Provide instruction to the Owner on the operation and maintenance of all installed mechanical systems.
- B. Personnel: Instruction on the operation and maintenance of products shall be by individuals trained and experienced in the installation, operation and maintenance of

these products. Instruction shall be by the product manufacturer's authorized service representative where indicated (see individual specification Sections).

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Protection of Items from Damage.
- B. Maintaining Utilities and Building Services.
- C. Cleaning.
- D. Temporary Systems.
- E. Review of Existing Conditions.
- F. Cutting and Patching.
- G. Deactivation and Cap-off of Systems.
- H. Mechanical Demolition and Disposal.
- I. Salvage and Reinstallation.

1.03 DEFINITIONS

- A. "Remove", "demo", and "demolish" mean "Remove and legally dispose of item and item accessories; except where indicated to be reinstalled, salvaged, or some other required work is indicated."
- B. "Salvage" means to "carefully remove, clean, pack for movement (drain of fluids, seal and protect from damage), and relocate to Owner's designated storage area (assume located within 5 miles of site, with 100 feet travel through facility storage area)."
- C. "Salvage and Reinstall (or Reinstallation)" means to "carefully remove, clean, pack for movement (drain of fluids, seal and protect from damage) and relocate to Contractor's selected (and suitable) storage area; reinstall as indicated after other work has been completed and as required by project schedule."

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials: All materials used for capping, temporary piping, repairs, reconnecting, reinstalling, and related work shall be same as specified for new systems.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection: Existing items not being demolished shall be protected against damage. Where necessary to prevent damage or necessary to accomplish other work, items shall be disconnected and moved to a suitable protective storage location during the project and then reinstalled to their original location.
- B. Utilities and Building Systems: Maintain existing utilities and building systems in service (unless indicated otherwise) and protect from damage during project. Where utilities or building systems must be shut-off to accomplish the work, see drawing notes, Section 20 05 00, and Division 01 for downtime limitations and Owner coordination and notification requirements; coordinate interruptions with other trades.
- C. Cleaning: All existing items that remain during construction and were affected by the construction shall be cleaned to a like new condition.
- D. Equipment and System Contents: Equipment and systems contain fluids that are typical for such items (e.g. HVAC units contain refrigerant, oils; hydronic systems contain ethylene glycol, corrosion control chemicals, etc.) and require special removal methods and disposal.
- E. Existing Items:
 - 1. Information and Field Verification: Routing, locations, and identification of existing items on plans are approximate and are limited. The relative location of systems shown on plans has not been verified, and is schematic only. Field verify locations, contents, and flow direction of all piping and ducts prior to performing any work associated with such systems (see also Section 20 05 00). Do not rely on existing labeling of systems; such labeling shall be considered wrong until verified by other physical evidence.
 - 2. Work Around: Existing building cavities (ceiling spaces, walls, etc.) contain a multitude of systems (e.g. conduit, wiring, fire suppression, light fixtures, low voltage system components, piping, ducts, etc.) typical for buildings of the type of this project. Added effort is required to identify and locate these systems, to work around such systems, and to temporarily disconnect and reconnect (and possibly remove and store) various building components to accommodate the work. Existing building elements will also require the work to be installed in smaller sections (i.e. shorter pipe or duct lengths) than normally possible, and to make system connections in awkward or cramped locations.
 - 3. Revisions: Revise existing systems as needed to accommodate project work and new finishes. Work shall include adjusting locations of items to suit new ceiling heights, revisions to building element locations, revisions to finishes, and other changes.
 - 4. Electrical: Verify voltage, phase, horsepower, panel circuits, and other electrical parameters of existing items prior to beginning work and ordering replacement products. Electrical data listed on the drawings for such items has not been field verified.
 - 5. Hydronic Systems: Unless noted otherwise, work on hydronic systems will require complete system drain down and re-filling to accomplish the work. Re-filling shall restore the system to pre-construction chemical concentration conditions, as indicated by the latest Owner's chemical test results. Systems that

contain glycol may have the glycol salvaged and reused in refilling the system provided the fluid to be reused is filtered through a 20 mesh strainer.

6. Controls: Verify existing communication protocol, existing component manufacturers, and model numbers, LAN type(s), software, location of devices, quantity of system points, methods used in terminating communication wiring, overall system performance, and sequences.
- F. Cutting: Provide all cutting and openings as necessary to accomplish the work indicated. No structural members shall be cut unless Structural Engineer's approval is obtained first. Assume all building members are "structural" unless clearly evident otherwise. See Section 20 05 00 and Division 01 for additional requirements.
- G. Patching: Patch all wall/floor/ceiling/roof openings left by removal of existing items where wall/floor/ceiling/roof is to remain. Patch with materials and workmanship so as to match finish of adjacent undisturbed area, and to provide conditions equivalent to the original new construction.
- H. Disposal: Dispose of all demolished items and all waste materials off site in accordance with code and legal requirements.
- I. Owner's Salvage: Owner has first right to all items shown to be demolished. All items not wanted by Owner, and not indicated to be salvaged for reuse, shall be removed by the Contractor.

3.02 REVIEW OF EXISTING CONDITIONS

- A. General: Provide field investigation of all systems and existing conditions to confirm extent of demolition, routing of existing systems, existing building materials of construction, mechanical system types and materials involved, areas where cutting and patching is required, site access, sizes of existing system components, and all other aspects of existing building and systems and their relationship to the Work.
- B. Review Timing: Review existing conditions prior to bidding, again prior to commencing any work or ordering materials, and continually throughout the project.
- C. Review for Space and Routing:
 1. Review existing conditions (including dimensions) where equipment must be moved through to confirm adequate space and path.
 2. Review existing conditions (including dimensions and locations of existing systems) where work will occur to determine impact on the locations and routing of new systems; include time to develop shop drawings and revisions to routing shown on the design drawings to accommodate existing conditions.
- D. Existing Record Drawings: Existing record drawings located at the Engineers office Owner's facilities office are available for review.
- E. Construction Thickness: Where needed to perform the work, and to prevent damage to adjacent construction, verify the thickness of existing concrete floors and other elements by selective drilling or saw cutting.

3.03 EXISTING CONSTRUCTION

- A. Hydronic Systems: Volume of each existing hydronic systems shall be assumed to be 1 gallon per building square foot (unless noted otherwise).
- B. Ceiling Construction: All ceiling construction shall be assumed to be two layers of 5/8" type X GWB installed over 2 x 6 20 gauge steel stud framing on 16" centers (unless noted otherwise).

3.04 DEMOLITION

- A. General: Review site conditions and identify all demolition work; include in bid all costs for demolition and disposal. Coordinate all demolition work with other trades. Confirm items to be salvaged or reused, and overall demolition scope.
- B. Scope: Not all items to be demolished are necessarily shown on the drawings, but are covered by notes and specifications. In addition to demolishing items indicated, demolish all associated items (unless indicated otherwise); this includes such items as supports, insulation, piping, drains, control wiring/conduit, power wiring/conduit, unions, valves, and similar accessories. Demolish all utilities serving demolished items completely or back to active mains where mains are to remain active; assume such utilities extend at least forty feet from the demolished items (unless indicated otherwise). Demolish all mechanical items located in building elements which are being demolished (i.e. located in walls, chases, roof assemblies, etc.). Demolish items as required to accomplish the work.
- C. Prevent Damage: Where existing building systems are to be reused to serve new items, carefully execute the demolition work to prevent damage to items to be reused and to prevent the demolition of items that are intended for reuse.
- D. Depth: Abandoned items, anchors, inserts, and other projections embedded in existing construction and not being concealed by new construction shall be removed to 1" below the adjacent finished surface, and the disturbed area patched.
- E. Cap-Offs and Terminations:
 - 1. Permanent: Provide cap-off of all existing utilities and systems that are cut or served demolished items. All cap-offs shall occur in concealed locations (unless indicated otherwise). Cap-offs shall be of equivalent material as the item being capped and be insulated where the connected system was insulated or where doing so will reduce energy consumption or prevent condensation.
 - 2. Temporary: Provide temporary cap-off of all existing utilities and systems to allow continued use of all systems until the final system components are installed and connected.
 - 3. Wiring Terminations: Terminate all control wiring and electrical power connections in a manner that complies with code and allows remaining items to function as intended.
- F. Equipment Services Reuse: Where equipment is being demolished and replaced with new at the same location, but new control or power devices (or other utility services) are not indicated to be provided; salvage and reuse the existing utility services (i.e. control devices, wiring, disconnects, starter, plumbing, etc.) that served the demolished item to serve the new item. Carefully remove items to prevent damage, and in a manner to allow reuse. Clean items that are going to be reused and all accessories to like new condition. Revise utility services as needed to serve the new equipment.

3.05 REUSED AND SALVAGED ITEMS

- A. General: Where indicated to be reused or salvaged, comply with the following.
- B. Removal: Carefully remove items to prevent damage and in a manner to allow for reinstallation. Remove all related items to the extent needed to allow for project work.
- C. Clean: Clean item and all accessories to like new condition.
- D. Package: Package item to allow for transport and storage without damaging. Label packaging to identify contents; include unique identifier number, brief description, and location (room number) item was removed from.
- E. Documentation: Compile a list of all salvaged items and documentation to allow for their reuse.
- F. Storage: Store items in secure and protective area until Owner (or project) is ready to receive.
- G. Reuse: For items indicated to be reused:
 - 1. Reinstall items and accessories as completion of other work allows. Provide all necessary connections and services to allow item to function properly; not all such connections are illustrated on the plans.
 - 2. Provide new fasteners, supports, anchors, gasketing, seals, pipe connectors, unions and related items to allow for complete and proper connections and operation of reinstalled items.

3.06 HAZARDOUS MATERIALS

- A. Hazardous Materials Discovery: If materials containing hazardous materials (other than those indicated) are discovered, do not disturb. Notify Owner to allow review and determine resolution. Assume in bidding and scheduling that there will be two occurrences of finding such materials, causing a 5 day project work stoppage each occurrence.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Thermometers.
- B. Pressure Gauges.
- C. Strainers.
- D. Unions.
- E. Flexible Connectors.
- F. Test Ports.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Submit product information data for all items to be used.

1.04 REFERENCES

- A. ANSI Z21.24: Connectors for Gas Appliances.
- B. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B16.39: Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.
- D. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- E. IFGC: International Fuel Gas Code.
- F. IMC: International Mechanical Code.
- G. UPC: Uniform Plumbing Code.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Thermometers: Trerice, Weiss, Winters.

- C. Pressure Gauges: Tterice, Weiss, Winters.
- D. Strainers: Watts, Keckley, Mueller, Sarco, Taco, Paco, Bell & Gossett, Armstrong, Wilkins.
- E. Unions: Anvil, Nibco, Watts, Epco, Victaulic, Ward, Jefferson Union.
- F. Dielectric Connecters: Victaulic Precision Plumbing Products, Elster Perfection.
- G. Flexible Connectors: Universal, Mason, Dormont, OPW, Unisource, Twin City Hose.
- H. Test Ports: Autoflow, Flowset, Peterson Equipment.

2.02 THERMOMETERS - INDUSTRIAL

- A. Type: 7 inch scale, adjustable angle, red reading mercury, industrial thermometer.
- B. Construction: Aluminum or polyester case, acrylic plastic or heavy glass window, aluminum face, stem of brass or aluminum construction, with separate brass socket (i.e. thermowell). Bulb chambers tapered to match taper in thermowell to give metal to metal contact. Scale case adjustable over a minimum 180° range, with locking fastener.
- C. Stem Length: Stem insertion length approximately one-half of pipe diameter. Where installed on tanks, minimum insertion length is 5". Where installed on insulated piping systems, provide a longer stem thermometer and extended neck socket (thermowell) to extend thermometer base past the insulation.
- D. Display: White background with bold black numerals and Fahrenheit degree markings, red or blue reading spirit.
- E. Accuracy: Plus or minus 1% of full scale.
- F. Ranges: Plus or minus 50% of systems normal operating temperature (at point of measurement), with figure intervals approximately 1/20th of range. For systems with multiple operating temperatures wider ranges may be used to allow the same thermometer type through-out the system.

2.03 PRESSURE GAUGES

- A. General: 4-1/2" round dial, stem mounting, black impact resistant phenolic (or fiberglass reinforced polypropylene) flangeless case, white face with black numerals, phosphor bronze bourdon tube rated to minimum 250 psi, brass socket, acrylic window, and 1/4" npt (or 1/2" npt) bottom connection. Shut off cock not allowed (use ball valve). Rated for use with the system pressures and temperatures to be exposed to, but be rated for no less than 250° F. Accuracy shall be 0.5% per ASME B40, 100 Grade 2A.
- B. Liquid Fill: Gauges used on pumps and where vibration or pulsation are present shall be liquid filled and be provided with a snubber. Liquid fill shall be suitable for ambient temperatures from 0 to 150° F, and for system temperatures to be encountered.
- C. Pressure Gauge Ranges: 0 to 1.5 times systems normal operating pressure (at point of measurement), with numeral figures on 5 psig for gauges reading to 100 psi, and 10 psig on gauges reading to higher values.

2.04 STRAINERS

A. Water Systems:

1. Copper Piping Systems 2-1/2" and Smaller: Bronze body, "Y" type, screwed or solder type end connections, 125 lb class (rated 125 psi steam working pressure at 350 deg F minimum) and 400 psi (WOG) rated working pressures at 210 deg F, stainless steel 20 mesh wire screen, and gasketed retainer cap. Reinforce wire mesh with perforated stainless steel sheet for sizes 2" and 2-1/2". Ratio of net free area of screen to pipe free area greater than 3.5. Provide with blowdown valve, ball type, with 3/4" NPT male end connection. Valve manufacturer shall be listed as an "Acceptable Manufacturer" in the hydronic piping system specification section.
2. Copper Piping Systems 3" and Larger: Bronze or ductile iron body, "Y" type, flanged end connections, 150 lb class (rated 150 psi steam working pressure at 400 deg F minimum), brass or stainless steel screen with 3/64" perforations for 3" and 3/32" perforations for larger sizes; with gasketed threaded retainer cap. Ratio of net free area of screen to pipe free area greater than 3. Provide with blowdown valve, ball type, with 3/4" NPT male end connection. Valve manufacturer shall be listed as an "Acceptable Manufacturer" in the hydronic piping specification section.
3. Steel Piping Systems: Ductile iron, cast iron, or carbon steel construction, "Y" type, 250 lb class (rated 250 psi steam working pressure at 450°F minimum), with stainless steel screen. Screen shall be 20 mesh for strainers up to 2" in size, and have 3/32" perforations on larger sizes. Sizes 2-1/2 inch and less shall have threaded end connections; larger sizes shall have flanged end connections. Provide with bolted and gasketed strainer cap on flanged strainers; provide threaded gasketed retainer cap on threaded strainers. Provide with blowdown valve, ball type, with 3/4" NPT male end connection. Valve manufacturer shall be listed as an "Acceptable Manufacturer" in the hydronic piping system specification section.

- B. Pump Suction Diffusers: Cast iron body, angle type, with steel straightening vanes, steel orifice cylinder (shall be stainless steel on open cooling tower systems), 16 mesh bronze start-up strainer, and permanent removable magnet. Orifice cylinder shall be designed to withstand differential equal to pump shutoff head (maximum 75 psi) and shall have a free area equal to 5 times cross section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and shall be replaceable. Unit shall be rated for 175 psi service up to 250 degrees F. Suction diffuser inlet shall match system piping (or next pipe size to), outlet shall match pump inlet. Unit shall have an adjustable foot support and minimum 3/4-inch NPT blowdown tapping and 1/4-inch NPT gauge tapping.

2.05 UNIONS

- A. Dielectric Unions: Shall not be used. Provide "dielectric connector" with standard union where union is required at connection point of dissimilar materials.
- B. Unions on Copper Pipe:
1. General: Pressure and temperature ratings to match (or exceed) piping system being installed in; minimum Class 125.

2. 2-Inch Pipe and Smaller: Wrought copper solder joint copper to copper union, complying with ASTM B16.18.
 3. 2-1/2-Inch Pipe and Larger: Brass flange unions.
- C. Unions on Steel Pipe:
1. General: Pressure and temperature ratings to match (or exceed) piping system being installed in; minimum Class 150.
 2. Threaded: Malleable iron union, threaded connections, with ground joints, complying with ASME B16.39. Provide with brass-to-iron seat (except provide iron-to-iron seat where the conveyed material is detrimental to brass).
 3. Welded and Flanged: Flange unions; see individual system specification sections.
- D. Dielectric Connector: Schedule 40 steel pipe nipple, zinc electroplated, with internal thermoplastic lining which is NSF/FDA listed and meeting all code requirements for potable water applications. Suitable for continuous use up to 225 deg F and 300 psi. "Clearflow" dielectric waterway (or approved). For systems operating at temperatures greater than 225 deg F provide flanged connections with insulating gaskets.

2.06 FLEXIBLE CONNECTORS

- A. Pump Flexible Connectors: Twin sphere type, constructed of peroxide cured EPDM with Kevlar tie cords, multilayered. Embedded solid steel rings shall be used at raised face flanged ends. Shall have an external ductile iron reinforcement ring between spheres. Rated minimum 225 psi at 230°F. Control rods shall be used as recommended by the manufacturer for the application; rods shall have 1/2-inch thick neoprene bushings, washers and accessories sized to accommodate system loads and conditions. Same size as pipe installed end, with end connections to suit connecting piping. Mason Industries "SafeFlex" SFDEJ Series, and SFDCR Series.
- B. Piping Flexible Connectors:
1. Fuel Gas Piping 1-1/4 inch and Smaller: Factory fabricated flexible gas connector, constructed of type 304 stainless steel tubing, corrugated, with brass or stainless steel threaded end fittings, and heavy PVC coating. Listed for use in fuel gas piping systems; complying with ANSI Z21.24 and IFGC. Size flexible connector to match pipe size shown on plan, with reducer after the flexible connector to match the equipment connection size (where connecting to equipment). Length as required to accommodate equipment movement relative to piping; minimum 18-inch length for sizes 1/2-inch diameter and less; minimum 24-inch length for larger sizes. Where used on appliances that require to be moved for cleaning or servicing, provide type listed for mobile appliance application, with adequate length to allow for appliance movement, and with a restraining cable and mounting hardware to prevent strain applied to gas connector.
 2. Fuel Gas Piping Larger than 1-1/4 inch: Factory fabricated flexible gas piping connector, constructed of series 304 or 321 stainless steel, with braided exterior, carbon steel (or stainless steel) threaded or flanged end connections, rated for 350 psig working pressure, For use with fuel gas piping systems and complying with IFGC. Size flexible connectors to match pipe size shown on plan, with

reducer after the flexible connector to match the equipment connection size.

2.07 TEST PORTS

- A. Temperature/Pressure Type: Test port for installation in tee in piping allowing insertion of probe for measurement of pressure and/or temperature. Valve shall be of brass construction, have 1/4-inch or 1/2-inch NPT male connection, with dual valves to prevent leakage and gasketed cap with attachment to test port. Rated for minimum 500 psi and 275 deg F. Provide extended length on insulated piping systems so that insulation does not cover the test port.

2.08 ESCUTCHEONS

- A. Type: Circular metal collar to seal pipe penetrations at building elements (i.e. walls, floors, cabinets, and ceilings); one piece type except that split hinge type may be used for applications on existing piping.
- B. Construction: Constructed of chrome plated brass or polished stainless steel, sized to tightly fit pipe exterior surface (or pipe insulation where insulated) and to fully cover the building element penetration.
- C. Projection: Shallow face type with maximum projection from wall not to exceed 1.2 times inner diameter of escutcheon.
- D. Special Applications: For sprinkler heads and similar special applications see items' specification Section.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Thermometers: Install thermometers and thermal wells in piping at locations indicated, and so as to be easily read.
- B. Pressure Gauges: Install pressure gauges at inlet and outlets of all pumps; at each side of pressure reducing valves; and as indicated. Provide with ball-type isolation valves.
- C. Unions: Install unions in pipe connections to control valves, coils, regulators, reducers, all equipment, and where it may be necessary to disconnect the equipment or piping for repairs or maintenance; and as indicated. Where flanged connections occur at equipment additional unions are not required unless indicated otherwise. Dielectric unions shall not be used.
- D. Dielectric Connectors: Install connectors between all connections of copper and steel piping (or equipment), and other dissimilar metals. Where flanged connections occur use insulating type flanges. Dielectric unions shall no be used.
- E. Flexible Connectors - Pumps: Install at all suction and discharge connections (except not required on pumps 1 HP and less).
- F. Flexible Connectors - Piping: Install at pipe connections to equipment with rotating elements (except not required at hydronic heating/cooling coils unless specifically noted), at building expansion joints, **where required for seismic isolation, per code**, and where

indicated. Provide flexible connector in gas piping connections to all equipment; size flexible connectors to match pipe size shown on plan, with reducer after the flexible connector to match the equipment connection size.

- G. Test Ports: Install at locations shown on drawings and where needed by Balancer to allow measurements for flow adjustments.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Pipe Hangers and Supports.
- B. Duct Hangers and Supports.
- C. Mechanical Equipment Anchors and Supports.

1.03 QUALITY ASSURANCE

- A. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) Standards SP-58, SP-89, SP-69, and SP-90.
- B. General: All methods, materials and workmanship shall comply with Code; including IBC, IMC, UPC, NFPA Standards, and ASME standards.

1.04 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data: Submit product data for all hangers, supports, and anchors. Data to include finish, load rating, dimensions, and applicable agency listings. Indicate application for all items by system type, size, and other criteria as appropriate to project.
- C. Shop Drawings:
 - 1. General: Shop drawings shall clearly indicate dimensions, anchor and support type, anchor and support size, anchor and support spacing, finish, configuration, and systems/equipment to be applied to.
 - 2. Attachments: Submit shop drawings for proposed attachment methods to building structure where the method of attachment has not been shown on the drawings, or where attachment methods other than those shown on the drawings are desired to be used.
 - 3. Fabricated Supports: Submit shop drawings for all fabricated supports.
 - 4. Finished Areas: Submit shop drawings for all supports that will be exposed in finished areas.

1.05 GENERAL REQUIREMENTS

- A. Seismic: Provide adequate hangers, supports, anchors, and bracing to serve as seismic restraints. Seismic restraints shall comply with Section 23 05 48. Provide seismic restraint calculations and information per Section 23 05 48 and as required by code.

- B. Design and Manufacture: All pipe hangers and supports shall be designed and manufactured in accordance with MSS-SP 58.

1.06 REFERENCES

- A. ADC: Air Duct Council - Flexible Duct Performance and Installation Standard, 5th Edition.
- B. ASHRAE-F: American Society of Heating, Refrigeration, and Air Conditioning Engineers, Handbook of Fundamentals.
- C. ASME B31.1: Power Piping.
- D. ASME B31.9: Building Services Piping.
- E. ASTM A36: Standard Specification for Carbon Structural Steel.
- F. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold - Finished.
- G. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- H. ASTM A153: Standard specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM A653: Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
- J. ASTM A907: Standard Specification for Steel, Wire, Epoxy - Coated.
- K. ASTM A924: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot Dip Process.
- L. IBC: International Building Code.
- M. IMC: International Mechanical Code.
- N. Federal Spec QQ-W-461H: Wire, Steel, Carbon (Round, Bare, and Coated).
- O. Mason SRG: Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork, Electrical Systems and Floor Mounted Equipment, 6th Edition.
- P. MSS SP-58: Pipe and Hangers and Supports - Materials, Design and Manufacture.
- Q. MSS SP-69: Pipe and Hangers and Supports - Selection and Application.
- R. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.
- S. MSS SP-90: Guidelines on Terminology for Pipe Hangers and Supports.
- T. SMACNA-DCS: HVAC Duct Construction Standards, 3rd Edition.
- U. SMACNA SRM: Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition.

- V. UPC: Uniform Plumbing Code.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Hangers and Supports: Grinnell, B-Line Systems, Unistrut, Erico, PHD, Basic-PSA, Pate, Caddy, Unisource, Metraflex, American Insulation Sales, Thermal Pipe Shields, Miro Industries.
- C. Anchors: Rawplug, Phillips, Hilti, Michigan, Simpson, Fastenal, Red Head, Grinnell, B-Line Systems, Unistrut, PHD, Basic-PSA, Metraflex.

2.02 GENERAL

- A. Finish:
- Indoor Applications: Electro-plated zinc in accordance with ASTM B 633, or hot-dip galvanized after fabrication in accordance with ASTM A 123; except that hanger straps may be formed from pre-galvanized steel.
 - Outdoor Applications: Hot-dip galvanized after fabrication in accordance with ASTM A 123, ASTM A 153, or ASTM A 653 (as applicable to item).
- B. Identification: Steel pipe hangers and supports shall be stamped with the manufacturer's name, part number, and size.
- C. Hanger Rods: Threaded hot rolled steel. Hanger rods shall be sized so that the total load imposed (including pipe or duct, insulation, hangers, and fluid) does not exceed the following:

<u>Nominal Rod Diameter</u>	<u>Maximum Load</u>
1/4 Inch	240 Pounds
5/16 Inch	440 Pounds
3/8 Inch	610 Pounds
1/2 Inch	1130 Pounds
5/8 Inch	1810 Pounds
3/4 Inch	2710 Pounds
7/8 Inch	3770 Pounds
1 Inch	4960 Pounds

- D. Hanger Straps: Galvanized steel, minimum 1" x 22 gauge (except where required by Code to be heavier or noted otherwise), of lock-forming grade conforming to ASTM A924, G90 (minimum) galvanized coating conforming to ASTM A 653. Minimum yield strength of 30,000 psi. Straps shall be sized so that the total load imposed does not exceed the following:

<u>Strap Size</u>	<u>Maximum Load</u>
1" x 22 Gauge	230 Pounds
1" x 20 Gauge	290 Pounds
1" x 18 Gauge	380 Pounds

1" x 16 Gauge	630 Pounds
1-1/2" x 16 Gauge	990 Pounds

- E. Beam Attachments: Constructed of malleable iron or steel, MSS standard types designed for clamping to building structural support beam. "C" clamp type shall have cup point set screws with locknuts and retaining straps. Center loaded type beam clamps shall have horizontally adjustable clamping bolt (or rod with nuts).
- F. Concrete Anchors: Wedge type expansion anchors, with hex nut and washer, and stainless steel split expansion rings. Tested to ASTM E 488 criteria, UL listed, with exposed anchor head stamped with code to identify anchor length.
- G. General Anchors (Screws, Nuts, Bolts, Fasteners):
 - 1. General: Constructed of materials suitable for the conditions exposed to and materials being joined, with minimum 50 year service life. Stainless steel construction where exposed to corrosive conditions. Configuration, size and grade to suit application, accommodate expected forces, and provide anchoring to structural element (or allow for proper fastening of items). Minimum safety factor of 2.5 (or as required by code, whichever is greater). Comply with ASTM A307, SAE J429, SAE J78, or ASTM A 563; bolts and nuts shall have unified inch screw threads (course, UNC).
 - 2. Test Reports: Provide independent test report indicating fastener strength (pullout and shear) as installed in the materials and applications of this project (when required by the Engineer or AHJ).
 - 3. Finish: In finished areas, the portion of fastener exposed to view shall match the exposed finish of item being fastened.
- H. Manufactured Strut Systems:
 - 1. Channels: Minimum 12 gauge, 1-5/8 x 1-5/8" (unless noted otherwise), with slots/holes to suit application.
 - 2. Accessories: Channel nuts press formed, machined and hardened with gripping slot, fabricated from steel conforming to ASTM A 108 or ASTM A 36. Fittings fabricated from steel in accordance with ASTM A 907.
 - 3. End Caps: Vinyl cap, capable of withstanding high temperatures without degradation, manufactured specifically for use with manufactured strut. Unistrut Series P2859 or P2860 (or approved).
- I. Steel: Structural steel per ASTM A 36.
- J. Wood: Only allowed to be used where building structural elements are of wood construction same type, grade used for building structural members. Where located outdoors shall be the pressure treated type; with all cut portions of wood painted with wood preservative.
- K. Field Galvanizing Compound: Brush or spray applied galvanizing treatment; consisting of a premixed ready to apply liquid organic zinc compound, with 95% metallic zinc content by weight in dry film. ZRC worldwide "ZRC Cold Galvanizing Compound".

- L. Rooftop Pipe Supports: Designed for rooftop support of piping to distribute load evenly over roof surface; factory fabricated. Shall be constructed of thermoplastic, polycarbonate, or polyethylene material, with attached strut support for anchoring of pipe, pipe attachment hardware, and sized to suit piping used with and so that pressure on roof does not exceed 150 pounds per square foot. Provide style with height to match pie height requirements above the roof. Strut and hardware shall be hot-dipped galvanized or have electro-galvanized finish. Plastic materials shall have UV stabilizers to resist UV deterioration. For piping systems subject expansion and contraction, provide roller type support allowing pipe movement, having a foam bottom to minimize roof abrasion. Caddy "Pyramid ST", Pyramid 50", "Pyramid 150", Pyramid RL".
- M. Rooftop Equipment Sleepers: Factory fabricated sleepers, constructed of minimum 18 gauge galvanized steel, all joints fully welded, with integral base plate pressure treated top wooden nailer, and integral top flashing having side turndown over wood nailer. Size to suit equipment supported, with minimum height above roof as indicated, and configuration to suit roof and roof insulation used with. Pate Co. "es-Equipment Supports", Thybar "TEMS", (or approved equal).

2.03 PIPE HANGERS AND SUPPORTS

- A. Copper Pipe: All hangers used directly on copper pipe shall be copper plated or have a factory applied 1/16-inch thick (minimum) plastic coating on all contact surfaces.
- B. Cushion Clamps: Pipe clamps with a vibration dampening insert between the pipe and clamp, with a nylon inserted lock-nut on clamp. Insert shall be constructed of a thermoplastic elastomer, designed to tightly fit and match pipe size and clamp used with; suitable for system temperatures.
- C. Type: Shall be MSS type selected in accordance with MSS-69; except that MSS type 24, 26, and 34 shall not be used.
- D. Trapeze Hangers: Shall be constructed of carbon steel angles, manufactured strut channels, or other structural shapes with flat surface (or installed saddle) for pipe support. Provide steel washer where hanger rod nuts bear on trapeze hanger. Pipe anchors shall be two piece clamp type designed for use with trapeze style (i.e. inserted into strut channel opening) or one piece type designed for welded or bolted attachment to trapeze; shaped to match pipe size (or pipe size plus insulation thickness on insulated systems). Pipe guides shall comply with paragraph titled "Alignment Guides"; or be steel angles with vertical leg height equal to pipe diameter (or pipe diameter plus insulation thickness on insulated systems); or be two piece clamp type pipe anchors sized and installed to serve as a guide.
- E. Insulated Pipe Supports:
 - 1. Insulation material at pipe support shall consist of expanded perlite, calcium silicate or high density phenolic. Where located outdoors or used on chilled water piping, insulation material, shall be water resistant. Insert shall have a flame resistant jacket of nylon reinforced kraft paper bonded to aluminum foil cover on insulation, with galvanized steel shield. Insulation material shall have no more than 5% deformation at 100 psi and a thermal conductivity no more than 0.32 Btu/hr-sf-deg F-inch (rated at 75 deg F). Insulation shall be suitable for temperatures and conditions it will be exposed to without degradation over a 30 year life.

2. All insulation and materials shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke development, as tested by ASTM E84.
3. Insert shall be same thickness as adjoining pipe insulation, sized to match pipe diameter used on.
4. Minimum insulation and shield lengths, and minimum shield gauge:

Nominal Pipe Diameter <u>In Inches</u>	Insulation Length <u>In Inches</u>	Shield Length <u>In Inches</u>	Minimum** Shield Gauge
1/2 to 1	*	4	20
1-1/4 to 2	6	4	20
2-1/2 to 6	6	4	18
Larger Sizes	9	6	16

* Insert not required; shield at insulation is acceptable.

** Provide with 360° shield where pipe is clamped (or has a 360° anchor).

2.04 DUCT HANGERS AND SUPPORTS

- A. Hangers: As shown in SMACNA-DCS except that wire shall not be used and all materials used shall comply with these specifications.
- B. Vertical Duct Supports at Floor: 1-1/2" x 1-1/2" x 1/8" (minimum) galvanized steel angle and to support ducts, maximum 12 foot on center, and as shown in SMACNA-DCS. For ducts over 30 inches wide provide riser reinforcing with hanger rods between the riser support and riser reinforcing.
- C. Vertical Duct Supports at Wall: 1-1/2" x 1/8" (minimum) strap or 1-1/2" x 1-1/2" x 1/8" (minimum) angle bracket and as shown in SMACNA-DCS.
- D. Hanger Attachments to Structure: As shown in SMACNA-DCS to suit building construction and as allowed on structural drawings. Provide washers at all fasteners through hanger straps (regardless of SMACNA-DCS allowances). Where C-clamps are provided, retainer clips shall be used. Friction beam clamps shall not be used.
- E. Hanger Attachments to Ducts: As shown in SMACNA-DCS except that wire shall not be used as any form of support or attachment for ducts.
- F. Flexible Duct Strap: Woven polypropylene hanging strap, minimum tensile strength of 400 lbs, minimum 1.75-inches wide, designed and intended for flexible duct support.
- G. HVAC Support Wire: Steel, minimum 12 gauge, soft-annealed wire, complying with Federal Specification QQ-W-461H, and IBC for support of ceilings and accessories installed in ceilings.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

- A. General: Provide all necessary bolts, nuts, washers, fasteners, turnbuckles, hanger rods, rod connectors, stanchions, wall/roof/floor backing and attachments, bridging between structural members, and any other miscellaneous accessories required for the support

and anchoring of all pipes, ducts, and mechanical equipment. All supports, whether from floor, walls, or hung from structure, are Contractor's responsibility. Anchors and supports shall be adequate to accommodate forces equipment will be exposed to. Any field cut pieces of galvanized materials shall be hot-dip galvanized after cutting; or be solvent and wire brushed clean and receive field applied galvanizing treatment. This field applied galvanizing (only allowed with prior permission for minor localized cuts) shall use multiple coats to provide as near equal protection as possible to factory (or hot-dip) applied coatings.

- B. Backing: Install steel or wood backing in walls (anchored to studs) and in ceiling (anchored to joists or trusses), as required to provide support for items.
- C. Installation: Install all inserts, anchors, and supports in accordance with manufacturer's instructions, code requirements, and best professional practices. The most restrictive criteria governs.
- D. Welded Assembly Finish: All welded steel support assemblies shall have a power wire brush and primer paint finish where installed indoors and be have factory applied hot-dip galvanized finish where installed outdoors (or subject to moisture); unless another finish is specified.
- E. Attachments: Attach to anchoring element (i.e. building structure, concrete pads, etc.) as shown on drawings (reference structural drawings). Where not detailed on the drawings, the Contractor shall design and submit shop drawings of proposed attachment methods to the Engineer for review.
- F. Application:
 - 1. Where not detailed on the drawings (or otherwise indicated), the selection and design of supports is the Contractor's responsibility, in compliance with code and Contract Document requirements; subject to submittal review and acceptance by the Engineer.
 - 2. Exposed supports in finished areas shall be arranged to minimize their visibility; be free of dents, scratches and labels, and be configured in a manner to match the decorum and finish of the room they are installed in. Exposed supports in finished areas shall be cleaned to allow for field painting (unless a chrome, stainless steel, or similar finish has been indicated).
 - 3. HVAC Support wire and flexible duct strap shall only be used for support of ceiling air inlets and outlets, or at flexible duct supports.
- G. Manufactured Strut ("Unistrut"): Provide end caps on all strut ends at the following locations:
 - 1. Where exposed to view in finished areas.
 - 2. Where near maintenance access paths.
 - 3. Where personnel injury could occur if the ends were not covered.
- H. Seismic: Provide bracing and added supports to restrain movement in a seismic event. Items serving as seismic restraints shall comply with Section 23 05 48.

3.02 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- A. General: Aboveground pipe shall be anchored to the structure to prevent sagging, to keep pipe in alignment, and to resist the forces the pipe will be exposed to; piping shall be supported independent of equipment so that no loads bear on the equipment.
- B. Adjustment: All pipe supports shall be provided with a means of adjustment for the aligning and leveling of the pipe after installation.
- C. Applications: Selection, sizing, and installation of pipe supports and accessories shall be in accordance with the manufacturers recommendations, standards MSS SP-89 and MSS SP-69, UPC, and IMC. Refrigerant piping and similar piping subject to vibration (i.e. high pressure tubing) shall be installed with cushion clamps.
- D. Support Spacing: Provide piping support spacing according to the most restrictive of the following: UPC, IMC, ASME B31.1, B31.9, local codes, manufacturers recommendations or Contract Documents specific requirements. Provide supports at each change in direction of piping and at each side of concentrated loads (such as in-line pumps, valves greater than size 5", and similar items).
- E. Trapeze Hangers: Four or more pipes running parallel may be supported on trapeze hangers provided the slopes of such pipes allow use of common trapeze. Suspend trapeze hanger from the building structure using hanger rods; attach to the building structure using concrete inserts, beam clamps, or other approved methods. Where trapeze width exceeds 30 inches, and where building attachment restrictions require more anchor points, provide three (or more) hanger rod supports. Provide pipe anchors to secure piping to trapeze on minimum 20 foot spacing; size and install pipe anchor to allow longitudinal movement of pipe (unless noted otherwise) with minimal vertical and transverse movement; where pipe is subject to expansion/contraction provide anchoring and alignment guides per paragraph titled "Thermal Expansion/Contraction".
- F. Vertical Piping Supports: Support piping at each floor line with pipe clamps and at intermediate points as required so that hanger spacing does not exceed allowable spacing and as required to prevent excessive pipe movement and so as to comply with the maximum spacings cited above. Support all pipe stacks at their bases with a concrete pier or suitable support. For vertical pipe drops which occur away from a wall or similar anchoring surface, provide angled bracing from nearest structure on two sides of drop to provide rigid anchoring of pipe drop.
- G. Pre-Insulated Pipe Supports: Protect all insulated pipe at point of support with pre-insulated pipe supports. Such supports shall be in place at time of installing pipe.
- H. Underground Pipe: Shall be evenly supported on approved bedding materials, as appropriate for the type of piping being used. Such bedding and backfilling shall be as specified in Section 23 05 90.

3.03 INSTALLATION OF DUCT HANGERS AND SUPPORTS

- A. General: Provide anchors and supports for all ductwork. Supports and hangers shall comply with SMACNA-DCS, except that hanger spacing and hanger maximum loads shall be governed by whichever is more restrictive between these specifications or SMACNA-DCS.
- B. Hanger Spacing -- Rectangular Duct:

<u>Duct Area</u>	<u>Maximum Spacing</u>
Up to 4 Square Feet	8 Feet
4.1 to 10 Square Feet	6 Feet
10 Square Feet and Up	4 Feet

C. Hanger Spacing -- Round Duct:

<u>Duct Area</u>	<u>Maximum Spacing</u>
Up to 24 Inch Diameter	8 Feet
25 Inch to 48 Inch Diameter	6 Feet
49 Inch Diameter and Up	4 Feet

- D. Hanger Spacing - Flexible Duct: 4 feet, and at changes of direction as needed to maintain duct elevation and smooth airflow.
- E. Vertical Ducts: Support at each floor level, but in no case less than on 12 foot intervals.
- F. Flexible Duct: Support with methods shown in ADC. Metal strap in contact with the flexible duct shall have minimum 1.5-inch width.
- G. Fittings: Provide supports at each change in direction of duct for ducts with 4 square foot area or more, or for ducts larger than 24 inch diameter. Locate hangers at inside and outside corners of elbows--or at each end of fitting on each side.
- H. Concentrated Loads: Provide additional supports at each side concentrated loads such as modulating dampers (24" x 24" and larger), duct heaters (18" x 18" and larger), sound attenuators (all sizes), and similar items.
- I. Exterior Duct: Provide supports for exterior ductwork as shown in SMACNA-DCS; spacing as specified herein.
- J. End of Duct: At end of duct run, hangar shall be located no more than 1/2 the allowed hangar spacing from the end of the run.

3.04 CEILING SERVICES

- A. Less than 20 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners (or ceiling support members) or to cross runners with the same carrying capacity as the main runners (or support members).
- B. 20 to 56 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing 20 pounds but not more than 56 pounds, in addition to the above, shall have two No. 12 gauge wire hangers (or minimum 1" x 22 gauge hangar straps) connected from the terminal or service to the ceiling system hangers or to the structure above. These added hangers may be slack.
- C. Greater Than 56 Pounds: Ceiling mounted services, air inlets/outlets, and accessories weighing more than 56 pounds shall be supported directly from the building structure by approved hangers.

3.05 MECHANICAL EQUIPMENT ANCHORS AND SUPPORTS

- A. General: Provide anchoring and supports for all mechanical equipment. All equipment shall be anchored to (or supported from) the building structure. In lieu of anchoring to the building, anchor outdoor equipment to the concrete pad serving the equipment.
- B. Suspended Equipment: Support as indicated on the plans. Where not indicated use the methods shown (or consistent with) Mason SRG and SMACNA-DCS; submit shop drawings of the proposed methods to the Engineer for review.
- C. Roof Mounted Equipment: Install on roof curbs or roof sleepers as indicated. Anchor equipment to the curb (or sleeper), with the curb (or sleeper) in turn anchored to the building structure.
- D. Vibration Isolation: Equipment shall be supported and anchored in such a way so that no equipment vibration is transmitted to the building structure.
- E. Seismic: Coordinate with requirements of Section 23 05 48; provide anchors and bracing to resist seismic forces.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Pipe Sleeves.
- B. Duct Closure Collars.
- C. Firestop Seals.
- D. Non-Firestop Seals.

1.03 DEFINITIONS

- A. Firestop System: Specific firestop materials or combination of materials installed in a specific way in openings in a specific rated assembly to restore (or maintain) the fire rating and smoke passage resistance properties of the assembly.
- B. Firestop Seal: Same as "Firestop System".
- C. Rated Assembly: Wall, floor, roof, ceiling, roof/ceiling or other construction which is required (by code or the Contract Documents) to have a fire-resistance rating, be a smoke barrier, or to limit the passage of smoke.

1.04 SUBMITTALS

- A. General: Shall comply with Section 23 05 00.
- B. Product Data: Provide product data on all material to be use. Provide MSDS for all sealants, caulks and similar materials.
- C. Shop Drawings – General: Shop drawings of proposed sealing/flashing assembly for roof and exterior wall penetrations.
- D. Shop Drawings – Firestop: Provide firestop system shop drawings showing:
 - 1. Listing agency's detailed drawing showing opening, penetrating items, and firestop materials. Drawing shall be identified with listing agency's name and number or designation, fire rating achieved, and date of listing for each firestop system.
 - 2. Identify where each firestop system is to be used on the project.
 - 3. Manufacturer's installation instructions.

4. For proposed systems that do not conform strictly to the listing, submit listing agency's drawing marked to show modifications and stamped approval by the firestop system manufacturer's fire protection engineer.
5. Other data as required by the AHJ.

1.05 REFERENCES

- A. ASTM A 36: Standard Specification for Carbon Structural Steel.
- B. ASTM C534: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- C. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- E. UL 1479: Standard for Fire Tests of Through-Penetration Firestops.
- F. UL 723: Surface Burning Characteristics of Building Materials.
- G. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.
- H. SMACNA-ARCH: SMACNA Architectural Sheet Metal Manual, 7th Edition.

1.06 GENERAL REQUIREMENTS

- A. Corrosion Protection: All sleeves exposed to water, moisture, chemicals, or subject to corrosion shall be constructed of corrosion resistant materials suitable for the exposure. Steel sleeves shall be hot dip galvanized after assembly. Provide additional coatings as noted or as required to resist corrosion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Firestop Seal Materials: 3M, Dow Corning.
- C. Non-Firestop Seal Materials: 3M, GE, Dow Corning, Tremco, Pecora, Sonneborn, Pipeline Seal & Insulator.

2.02 PIPE SLEEVES

- A. Diameter:
 1. Belowground: Inside diameter of belowground pipe sleeves shall be at least 2 inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), so as to allow free movement of piping.

2. Aboveground: Inside diameter of aboveground pipe sleeves shall be at least 1-inch larger than the outside diameter of the pipe or pipe covering (for covered piping systems), so as to allow free movement of piping.
 3. Large Movement: Provide larger sleeves where a larger space around pipe exterior is required by code, where specifically noted, where pipe movement will occur (i.e. expansion/contraction or seismic), at expansive soils, other unusual conditions are present, and where required to accommodate large piping movement.
- B. Length: Horizontal sleeves through finished areas (where sleeve is exposed to view) shall be sized to be flush with finished surfaces; other horizontal sleeves may terminate flush to 2-inches past the element being penetrated. Vertical sleeves shall be sized to extend one inch above the final floor elevation.
- C. Structural Type: Fabricated from schedule 40 steel pipe. Waterstop shall consist of fully welded 2-inch larger diameter collar, minimum 1/4 inch thick steel, located on sleeve so as to be centered within the element being penetrated. Provide waterstop on sleeves where sleeves are installed in the following locations: in cast-in-place concrete, where any part of the sleeve ends are exposed to water, where installed in floors with water-proofing or water stopping membranes, in rooms with floor drains, and where needed for anchoring/support purposes. Prime paint all surfaces with rust-inhibiting paint.
- D. Non-Structural Type: Fabricated from 18 gauge galvanized sheet metal or 22 gauge spiral seam galvanized steel duct. Provide with galvanized steel angle tabs, collars, or similar to allow for anchoring where sleeve cannot be retained in place by element being penetrated.

2.03 DUCT CLOSURE COLLARS

- A. General: Closure collars shall provide closure of opening between duct and opening in element penetrated and shall abut tight up to and overlap duct and shall consist of rolled angle material (for round ducts) and welded framed angles (for rectangular and round ducts).
- B. Size: Closure collars shall be sized to match duct and opening applied to and shall have minimum 2-inch overlap on duct side and 2-inch overlap at opening/penetrated element side but shall completely cover opening in element penetrated with minimum 1-inch overlap to undisturbed element (i.e. wall, floor, etc.).
- C. Material: Closure collars shall be fabricated of 20 gauge galvanized steel for ducts 15 inches diameter and less and shall be fabricated of 18 gauge galvanized steel duct for all larger ducts and all square and rectangular ducts.

2.04 FIRESTOP SEALS

- A. General: Commercially manufactured through-penetration and membrane-penetration firestop systems to prevent the passage of fire, smoke and gases, and to restore the original fire-resistance rating of the barrier penetrated.
- B. Listing: Firestopping shall be listed by UL in "Fire Resistance Directory" (category to match the application), or be qualified by another independent agency acceptable to the AHJ.

- C. Rating: Firestop system and devices shall be tested in accordance with ASTM E 814 or UL 1479, with "F" and "T" ratings as required to maintain the fire-resistance rating of the barrier penetrated, and as required by code.
- D. Fire Hazard: Materials shall have a flame spread of 25 or less, and a smoke development rating of 50 or less; when tested in accordance with ASTM E 84 or UL 723.
- E. Cabling Applications: Firestop systems used with loose electrical cabling shall be the type that allows for removal of the cable or installation of new cables without damage to the firestop system, or the need to replace or repair firestop materials.
- F. Insulation: Firestop system shall be applicable to insulated systems to allow the insulation to run continuous through the firestop system (unless noted otherwise).

2.05 NON-FIRESTOP SEALS

A. Indoor Sealants:

- 1. Smoke or Sound Sealant Applications: For use where a firestop seal is not required, but smoke or sound seal is required. Single component, elastomeric or acrylic latex type sealant with STC ratings per ASTM E90. Sealants shall be of the following types, or approved equal:
 - a. 3M "Smoke and Sound Sealant SS100".
 - b. Tremco "Tremstop".
- 2. Other Areas - Dry (Not Normally Exposed to Water/Moisture): Single component, latex sealant complying with requirements of ASTM C834. Sealants shall be of the following types, or approved equal:
 - a. Tremco Corporation "Tremflex 834".
 - b. Pecora Corporation "AC-20 Acrylic Latex".
 - c. Sonneborn Building Products "Sonolac".
- 3. Other Areas - Wet (Exposed to Water/Moisture): Single component, mildew resistant silicone sealant complying with requirements of ASTM C920, Type S, Grade NS, Class 25. Color white. Sealants shall be of the following types, or approved equal:
 - a. Dow Corning "786 Mildew Resistant Silicone".
 - b. Pecora Corporation "898 Silicone Sanitary Sealant".
 - c. Tremco "Tremsil 200".

B. Outdoor Sealants:

- 1. General: Single component, non-sag, low modulus, silicone elastomeric sealant conforming to requirements of ASTM C920, Type S, Grade NS, Class 100/50. Sealant shall be of the following types, or approved equal.

- a. Dow Corning "790 Silicone Building Sealant".
 - b. Pecora Corporation "890 Silicone".
 - c. Tremco "Spectrem 1".
- 2. Adjacent to Aluminum: Single component, non-sag, medium modulus, silicone elastomeric sealant conforming to requirements of ASTM C920, Type S, Grade NS, Class 50. Sealant shall be primer-less type for use in joints adjacent to fluoropolymer coatings. Sealants shall be of the following types, or approved equal:
 - a. Dow Corning "795 Silicone Building Sealant".
 - b. GE Silicones, Momentive, SCS2000 and SCS7000.
 - c. Pecora "895 Silicone".
 - d. Tremco "Spectrem 2".
- C. Expanding Foam Sealant:
 - 1. General: Single component, polyurethane insulating sealant with flame spread index of 25 or less and smoke development rating of 50 or less. Shall expand and fully cure within 24 hours to a semi-rigid, closed cell, water and air resistant foam. Sealant shall be of the following types, or approved equal.
 - a. DAP "Kwik Foam".
 - b. Fomo Products "Handi-Foam".
 - c. Todol Products "EZ Flo Gun Foam".
- D. Specialty: Packed fiberglass or wool insulation; with silicone sealant rated for use with temperatures and other conditions encountered.
- E. Grout: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout. Nonshrink; recommended for interior and exterior applications. Design mix shall provide 5000-psi, 28-day compressive strength. Premixed and factory packaged.

PART 3 - EXECUTION

3.01 PIPE SLEEVES

- A. General: Provide sleeves for all piping passing through walls, floors, partitions, roofs, foundations, footings, grade beams, and similar elements. Except that sleeves are not required at core drilled penetrations through solid concrete or where formed openings equivalent to a core drilled opening are provided.
- B. Installation: Set sleeves plumb or level (or sloped as required for sloped pipes) in proper position, tightly fitted into the work. Set sleeves properly in element for specified

projection past adjacent surfaces (see sleeve product specification); cut ends of sleeve as necessary.

- C. Insulation: Insulation shall run continuous through sleeves (unless noted otherwise).

3.02 DUCT CLOSURE COLLARS

- A. General: Closure collars shall be provided for all exposed ducts on each exposed penetration where the duct passes through any floors, walls, ceilings, roofs, partitions, and similar elements. Closure collars shall additionally be provided where so noted on the drawings and at all duct penetrations into mechanical rooms, boiler rooms, and rooms housing mechanical equipment (on both sides of the penetration).
- B. Installation: Collar shall be installed tight against surfaces and shall fit snugly around the duct or duct covering. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier of insulated ducts. Collars shall be anchored to element penetrated, with fasteners appropriate to material fastening to, on maximum 6 inch centers.

3.03 FIRESTOP SEALS

- A. General: At each through-penetration and membrane-penetration in rated assemblies, where required to limit the passage of smoke, and as required by code or in the Contract Documents, provide a firestop system. Firestop system shall be installed in accordance with the manufacturer's instructions and listing.
- B. System Selection: Contractor is responsible to select the firestop systems to be utilized, corresponding to the construction of the assembly penetrated, and types of penetrations. Contractor shall submit proposed firestop systems to be utilized, shall also review such systems with the AHJ and obtain AHJ approval.
- C. Preparation: Prepare surfaces as recommended by firestop material manufacturer. Examine and confirm that conditions are acceptable to proceed with the installation. Provide maskings and temporary coverings to prevent contamination or defacement of adjacent surfaces.
- D. Installation Review:
1. Notify Architect/Engineer when firestopping work is complete and ready for review. Provide minimum 7 days notice to allow scheduling of review. An independent testing agency may be utilized to perform an inspection.
 2. Notify AHJ when firestopping work is complete and ready for inspection. Provide sufficient advance notice to allow scheduling of the inspection without adversely impacting project schedule.
 3. Do not cover or conceal firestopping until all inspections have been satisfactorily completed.

3.04 NON-FIRESTOP SEALS

- A. General: Provide seals around all ducts, conduit, and piping passing through sleeves, walls, floors, roofs, foundations, footings, partitions, and similar elements. Seals shall be watertight where the penetration may be exposed to water or moisture. Provide type of

sealant to suit the application. Provide smoke and sound type at all penetrations of rooms which contain mechanical equipment on both side of element penetrated to a depth of 5/8-inch (unless noted otherwise).

B. At Sleeves:

1. Between Sleeve and Penetrated Element: Fill openings around outside of pipe sleeve with same material as surrounding construction, or with material of equivalent fire and smoke rating and properties that allow a tight seal between the sleeve and the surrounding construction. Seal full depth of sleeve for vertical penetrations.
2. Between Pipe and Inside of Sleeve: Provide sealant between outside of pipe or pipe covering (for covered piping systems) and inside of sleeve. Seal depth shall be minimum 1-inch each side. Provide Link Seal type for belowground penetrations, vault wall penetrations, and slab-on-grade penetrations (not required where flexible type sleeves are used).

C. No Sleeves: Provide "Link-Seal" type for belowground penetrations, vault wall penetrations, and slab-on-grade penetrations. Provide sealant at other areas, type to suit the application. Fully seal between outside of pipe or pipe covering (for covered piping systems) and surrounding construction. Seal depth shall be minimum 1-inch each side.

D. Preparation: Remove loose materials and foreign matter impairing adhesion of seal. Perform preparation in accordance with recognized standards and sealant manufacturers recommendations. Protect elements surrounding area of work from damage or disfiguration due.

E. Installation: Install sealants immediately after joint preparation. Install sealants free of air pockets, foreign embedded matter, ridges, and sags. Tool exposed joint surface concave and with a neat finished appearance.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Vibration Isolation.
- B. Seismic Restraints.

1.03 DEFINITIONS

- A. "Equipment" is defined to mean any item with power connections (fans, HV units, AHU units, etc.), and also to include all hoods; but does not include pumps less than 3 hp.
- B. "Equipment Requiring Vibration Isolation" is defined to be any equipment (as defined above) with rotating components (e.g. pumps, fans, etc.).

1.04 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data:
 - 1. Submit product data on all items to be used.
 - 2. Submit calculations showing vibration isolation selection for all isolation devices provided under this specification section (i.e. where isolation is not furnished integral with the equipment or by the manufacturer of the equipment).
- C. Shop Drawings: Submit shop drawings for all fabricated support assemblies.
- D. Submit calculations showing seismic restraint calculations, restraint selection, proposed locations of all seismic control bracing, and details of bracing construction.

1.05 GENERAL REQUIREMENTS - VIBRATION ISOLATION

- A. General:
 - 1. Select and provide all vibration isolation devices for all equipment requiring vibration isolation so as to provide complete installed mechanical systems free of the transmission of vibration and vibration generated noise to the structure.
 - 2. Vibration isolation is shown on the drawings for various items but is not shown for all items requiring isolation. Provide all isolation as indicated and specified herein.

- B. Supplier: Where not provided by the equipment manufacturer, all vibration isolation devices and support assemblies shall be supplied as a coordinated package by a single vibration isolation manufacturer, under this specification section.
- C. Equipment Manufacturer Items: Isolation devices furnished by equipment manufacturer shall comply with this specification section and be selected by the manufacturer to suit, and provide satisfactory performance, for the applications of this project.

1.06 GENERAL REQUIREMENTS - SEISMIC RESTRAINTS

- A. General: Mechanical equipment, piping, and ductwork seismic restraints are typically not shown on the drawings but are to be provided as specified herein. Contractor is responsible to select and provide all seismic anchoring devices for all mechanical equipment, all piping, and all ductwork.
- B. Seismic Restraint Systems:
 - 1. The Contractor shall retain a specialty consultant or equipment manufacturer to develop seismic restraint systems and perform seismic calculations in accordance with code and requirements specified in this section. Calculations, restraint selections, and installation details shall be done by a professional engineer experienced in seismic restraint design and installation and licensed in the State where the project is located.
 - 2. The seismic design, consisting of calculations, restraint selection, installation details, and other documentation, shall be submitted. This submittal shall be signed and sealed by a professional Engineer.
 - 3. The seismic restraint design shall clearly indicate the attachment points to the building structure and all design forces (in X,Y, and Z direction) at the attachment points. The seismic restraint engineer shall coordinate all attachments with the building's structural engineer of record, who shall verify the attachment methods and the ability of the building structure to accept the loads imposed.
 - 4. The seismic restraint design shall be based on actual equipment data (dimensions, weight, center of gravity, etc.) obtained from submittals or the manufacturers. The equipment manufacturer shall verify that the attachment points on the equipment can accept the combination of seismic, weight, and other loads imposed.
 - 5. Analysis should include calculated dead loads, static seismic loads, wind loads, and the capacity of materials utilized for the connection of the equipment or system to the structure. Analysis should detail anchoring methods, anchoring materials, anchor sizes, embedment, and related details. All seismic restraint devices should be designed to accept, without failure, the calculated seismic forces.
 - 6. Forces shall be calculated in accordance with accepted engineering practice and code requirements, using appropriate seismic "zone" and other factors for the building type, systems involved, and project location.
 - 7. This project's building is considered a "non-essential" facility, Risk Category III.

1.07 REFERENCES

- A. IBC: International Building Code.
- B. IMC: International Mechanical Code.
- C. MASON: Mason Industries Seismic Restraint Guidelines for suspended piping, Ductwork, Electrical Systems and Floor Mounted Equipment, 2005 6th Edition.
- D. OSHPD: Office of Statewide Health Planning and Development, State of California, Fixed Anchorage.
- E. SMACNA/SRM: Seismic Restraint Manual Guidelines for Mechanical Systems, 2nd Edition.
- F. UPC: Uniform Plumbing Code.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Products: Mason, Peabody, Kinetics Noise Control, Vibration Eliminators, VMC Group.
- C. Expansion Devices/Flexible Connectors: Unisource Manufacturing, Twin City Hose, and as specified in Section 23 05 19, 23 21 13, and 23 33 00.

2.02 NEOPRENE ISOLATORS

- A. Isolation Pads: Oil resistant bridge bearing neoprene pads, minimum 3/4-inch thick, with cross-ribbed or waffle design. Size pads for not more than 50 psi or as recommended by vibration isolator manufacturer. Provide load distribution plates (minimum 3/8" plate steel) to evenly load pads. Mason Type SW (or approved).

2.03 SEISMIC RESTRAINTS

- A. General: Comply with code, SMACNA-SRM and MASON.
- B. Materials:
 - 1. Steel shall be per ASTM A36; hangers and other devices shall be per Section 23 05 29 and as shown in SMACNA-SRM or MASON. Sheet metal used for bracing shall be no less than 16 gauge. Material for straps shall be galvanized steel, no less than 18 gauge.
 - 2. Cabling: Cables shall be minimum 1/8" diameter, 7 x 19 strand, galvanized steel with clear vinyl coating. Provide with galvanized thimble, clamps, and accessories. End termination and clamping/application shall comply with SMACNA-SRM.
- C. Flexible Connectors:
 - 1. Piping Systems:

- a. Flexible Connectors: As specified in Section 23 05 19.
 - b. Seismic "V" Connectors: "V" design connector with braided hose and attachment fittings. Shall be constructed of type 321 stainless steel hose and braid with carbon steel elbows and ends (for steel piping systems); and bronze hose and braid with copper elbows and ends (for copper piping systems). Unit shall allow for 2" movement in all planes, and have minimum 150 psi working pressure at the system temperature installed. Unisource Manufacturing (or approved).
2. Ductwork: Flexible connectors as specified in Section 23 33 00.

PART 3 - EXECUTION

3.01 VIBRATION ISOLATION

- A. Isolators shall be of the type indicated; except where not shown, type shall be as selected by vibration isolation manufacturer (or equipment manufacturer) to provide adequate isolation.
- B. Installation: Install all vibration isolators in accordance with isolator manufacturer's instructions and isolated equipment manufacturer's recommendations.

3.02 SEISMIC RESTRAINTS

- A. General: Provide seismic restraints as required by code and as specified. Comply with SMACNA-SRM, MASON, and code referenced standards for seismic provisions. Anchoring system and restraints shall be able to withstand anticipated seismic forces. Coordinate with equipment manufacturers for proper equipment anchor attachments to withstand anticipated forces. Coordinate with project structural engineer for attachment of seismic restraints to building.
- B. Piping: Longitudinal and transverse bracing shall be required for all piping 2-1/2-inch diameter and larger and on all fuel gas piping 1-inch and larger. Bracing shall be applied as follows:
 1. Transverse bracing shall occur at maximum intervals of 40 feet, except on fuel gas piping on maximum intervals of 20 feet.
 2. Longitudinal bracing shall occur at maximum intervals of 80 feet, except on fuel gas piping on maximum intervals of 40 feet. Transverse bracing for one pipe section may also act as a longitudinal bracing for a pipe section connected perpendicular to it, if the bracing is installed within 2 feet of the elbow or tee of similar size. Piping conveying fluids at 100 degrees F and higher shall have expansion devices provided in-between longitudinal braces to allow for thermal expansion.
 3. Bracing may be omitted when the top of the pipe is suspended 12 inches or less from the supporting structural member and the pipe is suspended by an individual hanger, per code.
- C. Ductwork: Longitudinal and transverse bracing shall be required for all round ducts 28 inches in diameter and larger, for rectangular ducts 6 square feet and larger, and on all

duct systems used for life safety and smoke control installed in either the horizontal or vertical position. Bracing shall be applied as follows:

1. Transverse bracing shall occur at maximum intervals of 30 feet (20 feet for essential facilities), at each duct turn and at the end of a duct run.
2. Longitudinal bracing shall occur at maximum intervals of 60 feet (40 feet for essential facilities). Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if bracing is installed within 4 feet of the intersection and sized and installed on the larger duct.
3. Groups of ducts may be combined in a larger size frame using overall dimensions and maximum weight of ducts. At least two sides of each duct must be connected to the angles of the brace.
4. Walls, including non-bearing fixed partitions which have ducts running through them, may replace a transverse brace.
5. Bracing may be omitted when the top of the duct is suspended 12 inches or less from the supporting structural members and on roof top ductwork.

D. Equipment:

1. Equipment Not Requiring External Vibration Isolation:
 - a. General: Shall be rigidly connected to the structure per Section 23 05 29. Restraints (where required) shall utilize welded steel frames, steel braces, straps, or cables. Provide elastomeric (or neoprene) pads (1/4" thick) between seismic straps and equipment.
 - b. Base Mounted Equipment:
 - 1) Provide anchorage per Section 23 05 29 and bracing as needed to maintain equipment anchorage with anticipated seismic forces.
 - 2) All equipment shall have seismic bracing where the height of the equipment is 3 or more times the smallest base dimension and where the equipment anchorage alone is not adequate to maintain equipment anchorage with anticipated seismic forces.
 - 3) All water heaters shall have seismic bracing. Equipment which utilizes (or contains) flammables, combustibles, or hazardous materials shall have seismic bracing where the equipment anchorage alone is not adequate to resist anticipated seismic forces.
 - c. Other Equipment: All equipment located 31" or more from the point of attachment to the supporting structure shall have seismic bracing. Equipment which utilizes (or contains) flammables, combustibles, or hazardous materials shall have seismic bracing.
2. Equipment with External Vibration Isolation:

- a. General: Restraints shall not impede operation of vibration isolators, and shall use methods complying with SMACNA-SRM or MASON.
- b. Base Mounted Equipment:
 - 1) All equipment shall have seismic bracing where the height of the equipment is 3 or more times the smallest base dimension and where the equipment vibration isolation components are not adequate to maintain equipment in place with anticipated seismic forces.
 - 2) Provide housed spring isolators, seismic snubbers, padded welded steel angle restraint assembly (with minimum 1/4" clearance between pad and equipment), or slack cable restraints.
- c. Other Equipment:
 - 1) All equipment located 31" or more from the supporting structure shall have seismic bracing. Equipment which utilizes (or contains) flammables, combustibles, or hazardous materials shall have seismic bracing.
 - 2) Utilize slacked cable bracing to accommodate equipment movement due to vibration isolator operation but installed so as to prevent more than 2-inch movement in any direction.
- E. Bracing Arrangements:
 - 1. Do not use branch ducts or piping to brace main runs or consider as braces for equipment.
 - 2. Do not brace items to dissimilar parts of a building or dissimilar building systems that may respond in a different mode during an earthquake. (Examples: wall and roof, solid concrete wall and lightweight roof, existing building structure and new isolated building structure.)
- F. Building Expansion Joints: At building expansion joint crossings, provide seismic "V" connectors in piping allowing at least 1 inch movement in all directions and flexible connectors in ductwork (on both sides of expansion joint) allowing at least 1/2 - inch movement in all directions. Provide multiple connectors as required. Provide flexible connectors in ductwork in four places, and of sufficient length to allow relative duct movement (i.e. from one side of building expansion joint to the other) of at least 1-inch in all directions; provide hanger types that will not hinder such movement.

3.03 TEST AND INSPECTION

- A. Field Inspections: Prior to initial operation, the vibration isolators and seismic devices shall be inspected for conformance to drawings, specifications, and manufacturer's data and instructions. Check all flexible connectors/expansion devices for proper location, guiding, and end anchoring.
- B. Vibration Isolator Inspection: After installation of isolators and seismic restraint devices, remove all shipping blocks and other items that may prevent proper isolator operation.

Inspect isolators to verify that the machinery moves freely on its spring isolators within limits of stops or seismic restraint devices. Eliminate or correct interferences.

- C. Tests: Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels. Re-balance, adjust, or replace machinery with noise or vibration levels in excess of those given in the machinery specifications or machinery manufacturer's data. Check for proper operation of expansion devices and associated items during system warm-up.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Air Balancing.
- B. Hydronic Balancing.
- C. Report.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Company: Submit name of Company proposed to do the balancing and sample balancing forms. Where the Company has not been pre-qualified, and substitutions are allowed after bidding (see Division 00 and 01), submit information regarding firm qualifications.
- C. Personnel: Submit list of personnel that will be assigned to the project and their qualifications, and list of past projects.
- D. Reports: Preliminary and final balancing reports.

1.04 REFERENCES

- A. AABC-NS: Associated Air Balance Council, National Standards for Field Measurements and Instrumentation.
- B. ASHRAE: Handbook of Fundamentals.
- C. ACGIH-IV: American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practice.
- D. NEEB-PS: National Environmental Balancing Bureau Procedural Standard for Testing, Adjusting and Balancing Environmental Systems.

1.05 GENERAL REQUIREMENTS

- A. General: Balancing shall be done by a company which specializes in this type of work and is totally independent and separate from the Company which has installed the systems to be balanced.
- B. Balancers Qualifications:
 - 1. General: Work of this Section shall be performed by balancing firms meeting the following and having prior approval from the Engineer:

- a. Professional Affiliation: Firm shall be an Associated Air Balance Council (AABC) member balancer or National Environmental Balancing Bureau (NEBB) certified balancer.
 - b. Experience: Firm shall have satisfactorily completed the balancing work for at least 5 similar projects in the last 3 years. Similar is defined to mean: within 10% of the same quantity of units and air inlets/outlets, involve same type of systems, be the same type of facility (i.e. school, hospital, etc.). The lead field balancer (i.e. the individual who will be on site directing and participating in the balancing efforts) shall have at least 5 years of experience performing balancing work on similar projects.
 - c. References: Have five references for similar projects which have been completed in the last three years that will give a good or better performance rating. References shall be engineers, architects, or building owners. As part of the qualification process at least three of these references will be contacted and a rating obtained for the following: timeliness of work (i.e. able to complete work on schedule), cooperative nature of balancer's staff (i.e. ability to work well as a team with other project trades and professionals), overall quality of balancing work, quality of balancing report. Each item will be rated on a scale of 1 to 5 (5 being excellent), with the result averaged, score must be of 4 or better.
 2. Pre-Qualified Balancers: As a convenience to the Contractor, the following balancing firms have been pre-qualified. This is not in any way intended to limit competition or prevent other firms from submitting qualifications, but is intended as an aid to Contractors by identifying firms that have been confirmed as meeting the qualification requirements.
 - a. Neudorfer Engineers
 - b. Hardin and Sons
 - c. Test Comm
 - d. Advanced Mechanical Services
 - e. Testing and Commissioning (TAC) Services
 - f. AccuABC
 3. Qualification Process: Firms not pre-qualified who desire to perform the balancing work shall submit a substitution request form in accordance with Contract Document requirements (reference Division 00 and 01). In addition to the information required on the substitution request form, submit: Company information, resumes of staff to be assigned, lists of projects, and references (with name of project, staff assigned to project, and contact name and phone number).
- C. Balancing Issues: Notify the Engineer in writing of all problems or discrepancies between actual conditions and what design documents show as work proceeds.
- D. Engineer's Authority: The Balancer shall be directly responsible to the Engineer and shall perform this work and make system adjustments as directed by the Engineer.

- E. Lead Balancer: The Balancer shall assign an individual as "lead balancer" to work in the field to directly supervise the balancing work and field technicians. This lead field balancer shall have at least 5 years of experience performing balancing work on similar projects.
- F. Added Site Visits:
 - 1. Trade Coordination Purposes: The Balancer shall include in his bid one extra site visit (beyond those otherwise included) and associated added time to assess system readiness for balancing, resolve system issues, coordinate balancing work, and perform other activities related to balancing and commissioning.

PART 2 - PRODUCTS

2.01 GENERAL INSTRUMENTATION

- A. General: Balancing equipment shall comply with Associated Air Balance Council recommendations for field measurement instrumentation.
- B. Calibration: All measuring instruments shall be accurately calibrated and maintained in good working order. Calibration dates and certifications shall be available at Engineer's request.
- C. Instruments: Shall be capable of:
 - 1. Air velocity instruments, direct reading in feet per minute with 2% accuracy.
 - 2. Static pressure instruments, direct reading in inches water gauge with 2% accuracy.
 - 3. Tachometers, direct reading in revolutions per minute with 1/2% accuracy; or revolution counter accurate with 2 counts per 1,000.
 - 4. Thermometers, direct reading in degrees Fahrenheit with 1/10 of a degree accuracy.
 - 5. Pressure gauges, direct reading in feet of water or psig with 1/2% accuracy.
 - 6. Water flow instruments, direct reading in feet of water or psig with 1/2% accuracy suitable for readout of balancing valve provided.

PART 3 - EXECUTION

3.01 GENERAL

- A. Workmanship: All measurements and adjustments shall be in accordance with AABC-NS, NEEB-PS, and ACGIH-IV and recognized best balancing procedures. Measurements and adjustments of equipment shall be executed in a manner consistent with the manufacturer's recommendations.
- B. Flow Rates:

1. General: All air and water systems shall be completely balanced and adjusted to provide the flow rates indicated (within tolerances indicated in this specification Section), and to produce an even heating and cooling effect and control response and to produce even water circulation.
 2. Balancer Determined: Where flow rates have not been indicated the balancer shall determine such flow rates using acceptable practices in accordance with AABC-NS, NEEB-PS, and ASHRAE standards and submit the proposed flow rates to the Engineer for review.
 3. Confirmation: Prior to beginning balancing confirm any flow rate changes since design with the submittals and flow rates indicated therein, and with the Engineer to confirm changes made since design. Assume that new flow rates will be issued.
- C. Controls: Consult and coordinate with the Control Contractor for the adjustment and setting of all control devices to allow for the balancing work, and for proper system operation and proper flow rates. Set all controls and valves as required to maintain design flow rates and temperatures as shown on the drawings. Make measurements and provide data to the Control Contractor to allow for proper control of items.
- D. Comfort Adjustments: Make final adjustments for flow rates in order to optimize each space's comfort, including such considerations as temperature, drafts, noise, pressurization, and air changes. Where variances are made from design values, state reasons in report (e.g., "too noisy", "too drafty," etc.). All such variances are subject to approval by the Architect/Engineer.
- E. Deficiency Reports: Submit deficiency reports where the work does not allow balancing to occur or balancing issues develop. Indicate date, system and equipment involved, location, description of deficiency, and related information to allow for diagnosing the problem. Provide suggestions for resolution where possible.

3.02 AIR BALANCING

- A. Pre-check of System: Prior to beginning balancing, perform, as a minimum, the following:
1. Verify that clean filters have been installed, that system is free from debris, and that all inlets/outlets are not obstructed.
 2. Check all fans and equipment to verify that proper start-up and system preparation has been done by the installing contractor.
 3. Check all door/window and similar building opening status to insure building is ready and proper pressurization can be obtained.
 4. Open all dampers to full flow position, check positions and operation of all motorized dampers to allow full system flows.
 5. Review controls and sequences of operation.
- B. Tolerances: All air flow rates (supply, return, and exhaust) shall be adjusted to within plus 5 percent and minus 5 percent of the values shown in the contract documents, except that relative space-to-space pressure relationships shall always be maintained

(e.g., restrooms shall be negative relative to other areas, general offices shall be positive, etc.).

- C. Draft and Noise Adjustments: All diffusers, grilles, and registers shall be adjusted to minimize drafts and to eliminate objectionable noise.
- D. Filters: Air balancing shall be done with new, clean air filters installed. Adjust air deliveries so that design quantities will be obtained when filters are half dirty. This condition shall be simulated by covering a portion of the filter area.
- E. Fan Speeds and Drives:
 - 1. Adjust fan speeds and fan drives (adjustable sheaves) as required to produce design flow rates.
 - 2. Where new sheaves are required, calculate sizing of new sheave and coordinate requirements with the Division 23 Contractor; Division 23 Contractor to furnish new sheaves. Replace existing sheave with new one furnished by the Division 23 Contractor; include bid costs for sheave replacements on all of belt driven fans.
 - 3. Adjust belts for proper tension.
- F. Marking: Upon completion of flow readings and adjustments permanently mark the balanced position of all balancing valves by stamping the indicator plate of the valve.
- G. Duct Traverse: Rectangular duct traverses shall measure the center of equal areas in the air flow stream, with centers not more than 6 inches apart. Round duct traverses shall measure at least 20 locations, with locations being the centers of equal annular area. Reference ACGIH Industrial Ventilation Manual.
- H. One Open Run: Balance each branch run so that there is at least one wide open run; balance branches relative to one another so that at least one branch damper is wide open (except that where unique conditions exist, and the Engineer gives prior approval, one open damper on runs or branches is not required).
- I. Data: Data to be measured/recorded and provided in report for all air handling systems and equipment:
 - 1. Floor plans clearly showing and identifying all diffusers, grilles, OA louvers, ducts and all other items where air flow rates were measured.
 - 2. Identify manufacturer, model number, size, and type of all air inlets/outlets.
 - 3. Initial, trial, and final air flow measurements for all diffusers, grilles, OA louvers, ducts, and all other items where air flow rates were measured.
 - 4. Design air flow rates and percentage final air flow rates are of design values.
 - 5. Final damper (or other balance device) final position (as a percentage of full open).
 - 6. The connected voltage and corresponding nameplate full load amps, and the initial and final amperages of all fan motors.

7. Initial and final RPMs of all fans.
8. Static pressures on inlet and outlet of all fans.
9. Fan initial and final CFMs.
10. Outdoor air CFMs (record minimum and maximum values).
11. Entering and leaving air temperatures across coils with coils operating at 100% capacity.
12. Static pressure drop across each filter bank and coil.
13. Final position of any speed controls (as percent of full).
14. In addition to data noted elsewhere, provide the following for all equipment which are part of balanced systems:
 - a. Equipment name and number (as used on drawings).
 - b. Service.
 - c. Equipment manufacturer and model number.
 - d. Sheave and belt sizes (where applicable).
 - e. Filters sizes and quantities (where applicable).
 - f. Motor manufacturer and complete nameplate data.
 - g. Design operating conditions.
 - h. Actual operating conditions (flows, pressure drops, rpm, etc.).

3.03 HYDRONIC BALANCING

- A. Pre-check of System: Prior to beginning balancing, perform, as a minimum, the following:
 1. Verify that all strainers have been cleaned.
 2. Examine fluid in system to verify system treatment and cleaning.
 3. Check for proper rotation and operation of all pumps.
 4. Verify that expansion tanks are not air bound and properly charged and that system is full of fluid.
 5. Verify that all air vents at high points in the fluid system are properly installed and are operating freely. Verify that all air has been removed from the circulating system.
 6. Open all valves to full flow position, close any bypass valves, and open fully balancing valves. Set temperature controls so that automatic valves are open to

full flow.

7. Check operation of automatic bypass valves and similar flow/pressure controls.
 8. Check and set operating temperature of equipment to design requirements when balancing by temperature drop.
 9. Check equipment for proper start-up and system preparation by installing contractor.
 10. Review controls and sequences of operation.
- B. Tolerances: All water flow rates shall be adjusted to within plus 5 percent and minus 5 percent of the values shown in the contract documents.
- C. Control Valve Bypass: Adjust control valve bypass valves so that pressure drop is the same for full flow-through bypass valve as for full flow-through control valve and controlled equipment.
- D. Marking: Upon completion of flow readings and adjustments permanently mark the balanced position of all balancing valves by stamping the indicator plate of the valve.
- E. Requirements for All Hydronic Systems: Data to be measured/recorded and provided in report:
1. Floor plans or schematics showing and identifying all valves, coils, pumps and other items where temperatures, pressure drops, or water flow rates were measured.
 2. Identify manufacturer, model number, size and type for all balancing devices.
 3. Initial, trial, and final water flow measurements (pressure drops, temperatures, and GPMs) for all items where measurements were made.
 4. Design water flow rates, and percentage final water flows are of design values.
 5. The connected voltage and corresponding nameplate full load amps, and the initial and final amperages of all pump motors.
 6. Pump operating suction and discharge pressures and final total developed head.
 7. Pump initial and final GPMs.
 8. Entering and leaving fluid temperatures at coils and major equipment.
 9. GPM flow of each coil and major equipment.
 10. Pressure drop across each coil and major equipment.
 11. Pressure drop across bypass valve.
 12. Final position of all valves (percent open or setting position on valve).
 13. Final position of any speed controls (as percent of full).

14. In addition to data noted elsewhere, provide the following for all equipment which are part of balanced systems:
 - a. Equipment name and number (as used on drawings).
 - b. Service.
 - c. Equipment manufacturers and model number.
 - d. Equipment capacities.
 - e. Motor manufacturer and complete nameplate data.
 - f. Design operating conditions.
 - g. Actual operating conditions (flows, pressure drops, etc.).

3.04 BALANCING REPORT

- A. General: A balancing report shall be submitted as specified herein, documenting all balancing procedures and measurements.
- B. Report Organization: The report shall be divided into logical sections consistent with the building or system layout (i.e. by floors, building wings, air handling units, or other convenient way). Tabulate data separately for each system. Describe balancing method used for each system.
- C. Preliminary Report: Two preliminary review copies of the balancing report shall be submitted to the Architect/Engineer when the balancing work is 90% complete (or as near 90% complete as possible due to uncompleted work of other trades). In addition to containing all the information required of the final report, the preliminary report shall contain a list of all the work required of other trades in order to allow the balancing work to be completed. The Architect/Engineer will review the preliminary report and inform the Contractor of any additional items or revisions required for the final report. Preliminary reports may be omitted where the Architect/Engineer grants approval.
- D. Final Report: Shall be included in the Operation and Maintenance Manual. Submit reports to Contractor for inclusion in Manuals (or, when manuals have been already sent to Engineer, send report to Engineer who will insert report into Manual). Provide number of reports as required to match quantity of O&M Manuals, but in no case less than five.
- E. Format: 8-1/2" x 11" size, neat, clean copies, drawings accordion folded. Report shall be typed, shall have a title page, table of contents, and divider sheets with identification tabs between sections. Information shall be placed in a three hole notebook, with the front cover labeled with the name of the Job, Owner, Architect/Engineer, Balancing Contractor, and Report Date.
- F. Electronic Copy: Provide copy of reports in *.pdf format; submit final report with closeout documents per Divisions 00 and 01. Provide two CD's with each having an electronic copy of the report in pdf file format. Label CD neatly same report labeling. Provide electronic pdf files to others for inclusion in electronic record documents.
- G. General Balancing Information Required:

1. At the beginning of the report, include a summary of problems encountered, deviations from design, remaining problems, recommendations, and comments.
2. List of instruments used in making the measurements and instrument calibration data.
3. Names of personnel performing measurements.
4. Explanation of procedures used in making measurements and balancing each system.
5. List of all correction factors used for all diffusers, grilles, valves, venturi meters, and any other correction factors used.
6. Areas where difficulties were encountered in obtaining design flow rates, or where unstable operating conditions may exist.
7. Note any parts of the system where objectionable drafts or noises may be present and efforts made to eliminate same and why they may still be present.
8. Note where variances from design values occur; explain why.
9. All specified measurements, balancing data, any additional recorded data, and observations.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Duct Insulation.
- B. Pipe Insulation.
- C. Equipment and Specialties Insulation.

1.03 DEFINITIONS

- A. R: Thermal resistance of insulation, in units of hr-sf-deg F/Btu.
- C. Subject to Damage: Items installed exposed less than 8 feet above the walking surface (i.e. floor, platform, roof, grade, etc.) adjacent to the item.
- D. Cold Surfaces: Surfaces that will have operating temperatures below the temperature of the surrounding air by at least 5 deg F or more; includes chilled water piping, cooling condensate piping, air conditioning ductwork, outdoor air ductwork, and similar systems. Surfaces shall be considered a cold surface unless specifically indicated otherwise.

1.04 QUALITY ASSURANCE

- A. All insulation and materials shall have a fire hazard rating not to exceed 25 for flame spread and 50 for smoke development, as tested by ASTM E 84, NFPA 255, and UL 723.

1.05 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Provide product data on all insulation materials to be used. Indicate thicknesses to be used.

1.06 GENERAL REQUIREMENTS

- A. Code Compliance: Contractor shall insulate all systems with the materials and thicknesses as required by code, but in no case shall the insulation be less than that specified herein. In some cases the specified insulation exceeds code, and shall be provided as specified. Not all systems requiring insulation by code are specified, but shall be provided with insulation where required by code.
- B. Insulation at Hangers: Insulation shall be continuous through hangers on all insulated systems (except ductwork). Inserts at hangers are specified in Section 23 05 29 and are considered as part of the hanger and support system. Inserts are required to be installed at the time of pipe installation and are intended to be installed by the Contractor installing the pipe hangers/supports. See Section 23 05 29.

1.07 REFERENCES

- A. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
- B. ASTM B 209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C 411: Standard Test method for Hot-Surface Performance of High Temperature Thermal Insulation.
- D. ASTM C 547: Standard Specification for Mineral Fiber Pipe Insulation.
- E. ASTM C 1136: Standard Specifications for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- F. ASTM C 1290: Standard Specification For Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- G. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. NCIIS: National Commercial & Industrial Insulation Standards, published by Midwest Insulation Contractors Association, 5th Edition.
- I. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.
- J. UL 723: Tests for Surface Burning of Building Materials.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph Part 2.01, Acceptable Manufacturers.
- B. Insulation: Johns Manville, Armacell, Owens-Corning, Knauf, Rubatex, Aeroflex, Pittsburgh Corning, GLT, Halstead, Gilsulate, Manson.
- C. Accessories: Johns Manville, Armacell, Owens-Corning, Knauf, Rubatex, Aeroflex, Pittsburgh Corning, GLT, Halstead, Duro Dyne, Gustin Bacon, Childers, RPR, Tee Cee, Lewco Specialty Products, JPS, Buckaroos, Manson.

2.02 DUCT INSULATION

- A. Type: Flexible blanket type, constructed of inorganic glass fibers bonded by a thermosetting resin, complying with ASTM C 1290, Type III. Johns Manville "Microlite" (or approved).
- B. Jacket: FSK type, vapor proof, consisting of an aluminum foil cover reinforced with glass fiber mesh, and laminated to kraft. Water vapor permeance shall not exceed 0.05 perms. Provide with joint sealing tape, minimum 2 inches wide, constructed of jacket material with adhesive to seal all joints.

- C. Thermal Conductivity: Shall not exceed 0.27 Btu-in/hr-sq ft-deg F at 75 deg F.
- D. Operating Limits: 40 degrees F to 250 deg F.
- E. Duct Insulation Thickness:
 - 1. General: Provide insulation densities and thicknesses to achieve the R values cited below. R values are for the insulation only, in their installed thickness, considering installed duct wrap stretch and in accordance with code.
 - 2. Lining: Where ducts have internal lining, the insulating properties of the lining may be credited toward meeting the required insulation R value; use R-3.65 per inch of installed liner.
 - 3. Supply Air Ductwork:
 - a. Inside Building and Within Building's Thermal Envelope: R-3.3 (except where ran exposed in conditioned spaces, no insulation is required).
 - b. Inside Building But Not Within Building's Thermal Envelope: R-7.3.
 - 4. Return Air Ductwork:
 - a. Inside Building and Within Building's Thermal Envelope: No insulation required; except where duct contains air that may vary by 10 deg F or more from the space the duct passes through, R-3.3 insulation shall be provided.
 - b. Inside Building But Not Within Building's Thermal Envelope: R-7.3.

2.03 PIPE INSULATION

- A. Glass Fiber:
 - 1. Type: Rigid molded type, constructed of glass fibers bonded by a thermosetting resin, complying with ASTM C 547 Type I. Insulation factory molded to match pipe size applied to. Johns Manville "Micro-Lok" (or approved).
 - 2. Jacket: ASJ type, vapor proof, consisting of a white kraft paper cover reinforced with glass fiber and bonded to aluminum foil, with longitudinal self sealing closure system. Provide with butt strips constructed of jacket material with adhesive to seal all joints. Water vapor permeance shall not exceed 0.02 perms.
 - 3. Thermal Conductivity: Shall not exceed 0.24 Btu-in/ hr-sq ft-deg F at 75 deg F.
 - 4. Operating Temperatures: 0 deg F to 850 deg F.
- B. Pipe Fittings: Shall be covered using any one of the following methods of the Contractor's choice:
 - 1. Prefabricated segments of pipe insulation of same materials and thickness as the adjoining pipe insulation, formed to match pipe fitting.

2. Pre-cut fiberglass insulation and pre-molded high impact, gloss white, UV resistant, minimum 20 mil thick, PVC covers suitable for the pipe size and insulation thickness application, PVC cover shall be Johns Manville "Zeston 2000 PVC" (or approved).
 3. Insulating plastic cement brought up the full height of the adjacent covering.
 4. Except, where colored PVC jacketing is applied to piping, fittings shall use PVC covers of the same thickness and color as the PVC jacketing specified for the piping.
- C. Metal Jacket: Aluminum roll jacketing, factory formed to match pipe size and insulation application, with smooth surface, manufactured from 3003 or 5005 aluminum alloy, H-14 temper, conforming to ASTM B 209. Shall be minimum 0.020 inches thick, with an integrally bonded interior 1 mil thick heat bonded polyethylene moisture barrier over the entire surface in contact with the insulation. Fitting covers shall be fabricated of same material as pipe runs, factory formed to match fitting.
- D. Pipe Insulation Thickness:
1. General: Provide minimum piping insulation thickness indicated, in inches.

INSULATION THICKNESS (INCHES)					
Nominal Pipe Diameter (Inches)					
Fluid Design Operating Range, deg F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Above 350	4.5	5.0	5.0	5.0	5.0
251 - 350	3.0	4.0	4.5	4.5	4.5
201 - 250	2.5	2.5	2.5	3.0	3.0
141 - 200	1.5	1.5	2.0	2.0	2.0
61 - 140	1.0	1.0	1.5	1.5	1.5
40 - 60	0.5	0.5	1.0	1.0	1.0
Below 40	0.5	1.0	1.0	1.0	1.5

2. Varying Temperatures: Where a system operates over temperature ranges calling for different insulation thicknesses, the thicker insulation requirements shall be met.
3. Outdoor Piping: Piping exposed to outside air or, located outside the building/thermal envelope, shall have insulation thickness increased by 0.5 inch from that indicated above.

2.04 EQUIPMENT AND SPECIALTIES INSULATION

- A. Flexible Glass Fiber:
1. Type: Flexible blanket insulation, constructed of inorganic glass fibers bonded by a thermosetting resin, complying with ASTM C 553, Type III. Johns Manville "812 Spin-Glas" (or approved).
 2. Jacket: FSK type, vapor proof, consisting of an aluminum foil cover reinforced with glass fiber mesh, and laminated to kraft. Water vapor permeance shall not

exceed 0.05 perms. Provide with joint sealing tape constructed of jacket material with adhesive to seal all joints.

3. Thermal Conductivity: Shall not exceed 0.24 Btu-in/ hr-sq ft-deg F at 75 deg F.
4. Operating Temperature Limits: 40 deg F to 450 deg F.
5. Density: 1.5 lb/cu ft.

B. Elastomeric:

1. Type: Flexible cellular elastomeric insulation, complying with ASTM C 534, Type II.
2. Thermal Conductivity: Shall not exceed 0.30 Btu-in/ hr-sq ft-deg F at 75 deg F.
3. Water Vapor Transmission: Water vapor permeance shall not exceed 0.08 perms.
4. Operating Temperatures: -200 deg F to 220 deg F; shall be able to withstand 250 deg F temperatures for 96 hours per ASTM C 411 with damage or deformation.
5. Weather Protection: Where installed outdoors provide with metal jacketing to protect from UV and weather exposure.

C. Removable Insulation Blankets:

1. Type: Flexible blanket insulation pads, for insulating valves, unions, strainers and similar items. Constructed of exterior fabric enclosure sewn around interior insulation, held in position with a closure system that allows for removal of the blanket. Contractor or factory fabricated.
2. Enclosure - Cold Application: Silicone impregnated glass fiber cloth; chemical and oil resistant; water proof; flame and abrasion resistant; minimum 20 ounce/square yard weight. Lewco Specialty Products 3000 SA-2 (or approved).
3. Insulation: Thermal insulating wool, 1-inch thick, complying with ASTM C 553. Maximum thermal conductivity 0.22 Btu-in/ hr-sq ft-deg F at 75 degrees F. Provide in layers to give equivalent R value to the adjacent insulated piping. Owens Corning "Fiberglas Brand TIW, Type II".
4. Closure System: Velcro, zipper or steel lacing. Steel lacing anchors shall have spindles and self-locking washers, fabricated of minimum 14 gauge stainless steel, with stainless steel wire ties. AGM Industries "Series NLA" (or approved). Closure shall be configured to allow for complete coverage and closure of the insulation around the object being insulated. Closure for cold surfaces (surfaces that operate below ambient air temperature) shall provide a sealed vapor barrier so that no surfaces are exposed to ambient air and so that no condensation can occur; overlap enclosure ends (or any vapor barrier penetrations, as caused by suing steel lacing anchors) with an added vapor barrier cover, minimum 2-inches past the vapor barrier penetration; with Velcro (or equivalent) closure.

- D. Corner Angles: 0.016 inch thick aluminum, alloy 3003 or 5005, with factory applied Kraft backing, complying with ASTM B 209.
- E. Metal Jacket:
 - 1. Steel: Minimum 24 gauge galvanized steel complying with ASTM A 653. Provide with longitudinal slip joints and 2-inch laps.
 - 2. Aluminum: Minimum 0.020-inch thick aluminum, alloy 3003 or 5005, complying with ASTM B 209. Provide with longitudinal slip joints and 2-inch laps.
- F. Equipment and Specialties Insulation Types and Thickness:
 - 1. Unless a specific type of insulation is specified or noted, any of the insulation materials specified in this specification section may be used provided such application is in conformance with NCIIS.
 - 2. Insulation Thickness: Insulation thickness shall be the same as that specified for the piping or ductwork connected to the item, or as specified for the system the item is installed in (unless noted otherwise). Insulation thickness shall in no case be less than 1 inch thick.
 - 3. Valves:
 - a. 2 Inches and Smaller: Insulate with same material as piping system.
 - b. 2-1/2 Inches and Larger: Removable blanket insulation.
 - 4. Control Valves: Removable blanket insulation.
 - 5. All equipment and specialties where access is required shall have removable insulation blankets; other removable insulation materials per NCIIS may be used where pre-approved by the Engineer. Items requiring such removable insulation include, but are not limited to, the following:
 - a. Strainers.
 - b. Pumps.
 - c. Balancing valves.
 - d. Pressure/temperature/flow measuring devices.
 - e. Pump suction diffusers.

2.05 ACCESSORIES

- A. Adhesive, Caulks, Mastics, and Coatings: As recommended by insulation material manufacturer and suited for the application.
- B. Bands: 1/2-inch wide, of stainless steel, galvanized steel, or aluminum construction, to match with materials used with.

- C. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length shall be as required for insulation thickness used with. Welded pin holding capacity 100 lb, for direct pull perpendicular to the attached surface. Style and type to suit application.
- D. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness used with. Adhesive as recommended by the anchor pin manufacturer as appropriate for surface temperatures and materials used with, and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface. Style and type to suit application.

PART 3 - EXECUTION

3.01 GENERAL

- A. Pre-Insulation Review: No covering materials shall be applied until systems to be covered have had all tests satisfactorily completed, have had all required inspections, and have been satisfactorily reviewed by the Architect-Engineer. All systems shall be examined by the Contractor to confirm cleanliness and other conditions are appropriate to allow for insulation installation.
- B. Insulation Work Review: No insulated items shall be concealed in the building structure or buried until the insulation work has been satisfactorily reviewed by the Architect-Engineer, and has had all required inspections.
- C. Standards: Materials shall be installed in accordance with manufacturer's written instructions, NCIIS, and shall comply with materials and methods specified herein. The more stringent requirements govern.
- D. Joints/Seams: Joints shall be staggered on multi layer insulation. Locate seams and joints in least visible location.
- E. Insulation Protection: Insulation shall be kept clean and dry and shall be protected from dirt, damage, and moisture. Insulation that becomes dirty, damaged, or wet and cannot be restored to like new condition will be rejected, and shall immediately be removed from the jobsite.
- F. Insulation Interruptions: Insulation shall be neatly finished at all supports, protrusions and interruptions. Provide adhesive and tape seal to maintain vapor barrier integrity.
- G. Equipment and Floor Protection: Cover existing equipment and finished floors to protect such items from insulation fiber and dust. Keep all such existing areas in a "broom clean" condition at the end of each day. Take precautions in these areas to prevent glass fiber and insulation dust from entering ventilation systems or areas adjacent to the work.
- H. Glass Fiber Insulation - General:
 - 1. Finish all insulation ends with joint sealing tape or vapor barrier mastic, no raw edges allowed.
 - 2. Joints: Tightly butt adjacent insulation sections together without any voids. Provide overlap of jacket material over all joints.

- I. Items To Be Insulated: Provide insulation on all ductwork, all piping, all items installed in these duct and piping systems, all air and liquid energy conveying systems and components, all air and liquid energy storage, all equipment, and all energy consuming devices, except where such insulation has been specifically excluded.

3.02 DUCT INSULATION INSTALLATION

- A. Types and Thickness: Insulate all ducts with insulation type and thickness (to provide the required R value) as specified in "Part 2 - Products".
- B. General: Insulation shall be firmly butted at all joints. All longitudinal seams for flexible insulation shall overlap a minimum of 2 inches. All joints and seams shall be finished with appropriate joint sealing tape. Installation shall provide a continuous sealed vapor barrier over all surfaces; seal all jacket penetrations with vapor barrier mastic or vapor barrier jacket tape.
- C. Attachment: For rectangular ducts over 24 inches wide, duct insulation shall be additionally secured to the bottom of the ductwork with mechanical fasteners on 18 inch centers to reduce sagging. Washers shall be applied without compressing the insulation. Protruding ends or fasteners shall be cut off flush after washers are installed. All seams, joints, penetrations, and damage to the facing shall be sealed with joint sealing tape or vapor retardant mastic or appropriate joint sealing tape.

3.03 PIPE INSULATION INSTALLATION

- A. Types and Thickness: Insulate all piping with insulation type and thickness as specified in "Part 2 - Products". All piping shall be insulated except where specifically excluded.
- B. General: All ends shall be firmly butted together and secured with joint sealing tape. All jacket laps and joint sealing tape shall be secured with outward clinch staples at 4 inch spacing, or by use of a suitable adhesive. Installation shall provide a continuous sealed vapor barrier over all surfaces; seal all jacket penetrations with vapor barrier mastic or vapor barrier jacket tape.
- C. Pipe Hangers: Provide insulation tight up to pre-insulated pipe supports at pipe hangers, seal all joints with joint sealing tape. Pre-insulated pipe supports are specified in Section 23 05 29.
- D. Pipe Sleeves: Run insulation continuous full size through sleeve. Coordinate work with fire seals and confirm fire seal system is approved for use with insulated pipes; see Section 23 05 30.
- E. Metal Jacketing: Provide metal jacket over piping insulation for outdoor exposed piping.

3.04 EQUIPMENT AND SPECIALTIES INSTALLATION

- A. Types and Thickness: All equipment and items installed in insulated duct and piping systems shall be insulated except where specifically noted not to be; reference paragraph 3.01. Insulation type and thickness shall be as specified in "Part 2 - Products".
- B. General: Apply insulation as close as possible to equipment by grooving, scoring, and beveling as necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires or bands. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. Comply with NCIIS.

- C. Removable: All equipment and specialties where access is required for maintenance, repair, service, or cleaning shall have insulation installed so that it can be easily removed and reinstalled without being damaged and without requiring new insulation. Removable insulation shall completely cover the item being insulated with an overlap over adjacent insulation to cover all joints. Insulation on cold surfaces shall provide a sealed vapor barrier so that no surfaces are exposed to ambient air and so that no condensation can occur; overlap enclosure ends minimum 2-inches.
- D. Nameplates: Do not insulate over nameplates or ASME stamps; bevel and seal insulation around.
- E. Jacketing: Provide all equipment insulation with vapor retardant jackets.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Commissioning of Mechanical Systems.
- B. Documentation.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Qualifications: Submit qualifications of the firm proposed to perform the commissioning work and for the individuals that will be assigned.
- C. Commissioning Data:
 - 1. Commissioning plan.
 - 2. Commissioning preliminary report.
 - 3. Commissioning final report.

1.04 GENERAL REQUIREMENTS

- A. General: Commissioning shall be done by a Company which specializes in this work and independent and separate from the Companies installing the systems to be commissioned.
- B. Company Experience: The Company providing the commissioning work shall be experienced in commissioning HVAC control systems, and have commissioned at least five similar projects in the last three years. Company shall be certified for such work by AABC, NEBB, AEE, BCA, or ASHRAE.
- C. Individual Experience: The individuals performing the commissioning work shall have at least five years experience in commissioning, with the individual in the field in charge or the work having commissioned at least five similar projects in the last three years.
- D. Deferred Test: Tests may be deferred to allow for proper climatic or other conditions.

1.05 REFERENCES

- A. AABC: Associated Air Balance Council.
- B. AEE: Association of Energy Engineers.
- C. BCA: Building Commissioning Association.

- D. NEBB: National Environmental Balancing Bureau.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. General: Provide commissioning as required by code and as specified herein.
- B. Building Occupancy: Building or portions thereof, required by code to be commissioned, shall not be considered ready for occupancy until such time that the Engineer and building official determine that the preliminary commissioning report required by this Section has been completed.

3.02 NON-HVAC SYSTEMS

- A. General: All automatically controlled systems for which energy consumption, performance, or mode of operation are regulated by Code, shall be tested to ensure that control devices, equipment and systems are calibrated, adjusted and operate in accord with approved plans and specifications.
- B. Sequences: Sequences of operation shall be functionally tested to ensure they operate in accord with plans and specification.

3.03 HVAC SYSTEMS

- A. General: HVAC equipment and HVAC control systems shall be tested to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved plans and specifications.
- B. Sequences: Sequences of operation shall be functionally tested to ensure they operate in accordance with approved plans and specifications.
- C. Conditions: Testing shall affirm operation during actual or simulated winter and summer design conditions and during full outside air conditions.
- D. HVAC Equipment: Equipment functional performance testing shall demonstrate the installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed. Testing shall include all modes and sequence of operation, including under full-load, part-load and the following emergency conditions:
1. All modes as described in the sequence of operation.
 2. Redundant or automatic back-up mode.
 3. Performance of alarms.

4. Mode of operation upon a loss of power and restoration of power.
- E. HVAC Controls: HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with approved plans and specifications. Sequence of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.
- F. Economizers: Air economizers shall undergo a functional test to determine that they operate in accordance with manufacturer's specifications.

3.04 DOCUMENTATION

- A. Format:
 1. Hard Copy: Provide reports in 8-1/2 x 11 format, in 3 ring notebooks, with labeled cover and spine, clean legible, and logically organized with table of contents, divider tabs, and names of companies involved in the project, commissioning company name, commissioning personnel, and contact information. Provide 3 copies per Divisions 00 and 01.
 2. Electronic: Provide copy in *.pdf format; submit with closeout documents per Divisions 00 and 01.
- B. Test Plan: Prepare a written commissioning test plan and submit for approval prior to beginning commissioning work. Test plan to include:
 1. Equipment and systems to be tested.
 2. Roles and responsibilities of individuals performing the commissioning and of others involved in the project.
 3. Functional test procedures and forms.
 4. Conditions under which the test shall be performed (for example, winter design conditions, full outside air, etc.).
 5. Expected systems' response or acceptance criteria for each procedure.
 6. Time schedule for performance of the work; including any deferred tests.
 7. Forms as required by the WSEC or AHJ.
- C. Preliminary Commissioning Report:
 1. General: A preliminary report shall be issued to identify issues preventing the commissioning work from being completed. If all commissioning work can be fully completed and the final report completed, a preliminary report is not required.
 2. Report: Compile all system and commissioning data; including all reviews, inspections, test procedures, and tests. Report shall include field notes of commissioning activities, equipment and system data, test procedures, tests

performed, actual results as compared to expected (or specified) results, WSEC and any AHJ required commissioning forms (completed to the extent possible).

3. Items to Complete: The preliminary report shall identify items needed in order to complete the commissioning, including:
 - a. Deficiencies found during testing required by this Section, which have not been corrected at the time of report preparation.
 - b. Deferred tests which cannot be performed at the time of report preparation due to climatic (or other) conditions.
 - c. Climate (or other) conditions required for performance of the deferred tests, and the anticipated date of each deferred test.
 - d. Proposed schedule for completion of report.
- D. Final Commissioning Report: Complete all commissioning work not previously completed and included in the preliminary report. Provide a complete final report with all systems and commissioning data; including test plan, all reviews, inspections, test procedures, tests, and results. Final report shall include all documentation required for the preliminary report and documentation regarding resolution of previous cited deficiencies.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Thermowells.
- B. Control Tubing.
- C. Control Damper Installation.
- D. Control Valve Installation.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Submit product data for all items to be used.

1.04 GENERAL REQUIREMENTS

- A. General: The control system is specified in Division 25. The Division 23 contractor is required to coordinate the work with the control systems work to allow installation of items required for the HVAC control system, and to install the control items indicated.
- B. Control Dampers: Furnished under Division 25 and installed under this specification section.
- C. HVAC Control Valves: Furnished under Division 25 and installed under this specification section.

1.05 REFERENCES

- A. ASTM B88: Standard Specification for Seamless Copper Water Tube

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Thermowells: Terrice, Ashcroft, IPS, RTD, Texas Thermowell, Thermometrics.

2.02 THERMOWELLS

- A. Series 300 stainless steel or brass construction, with 2 inch lagging neck and extension type well. Diameter and insertion length to suit application.

2.03 TUBING

- A. Soft Copper tubing, per ASTM B 88; with soldered or flared/screwed type fittings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install items in accordance with manufacturer's instructions and control system requirements. Coordinate all work requirements with Division 25.
- B. Thermowells: Provide all HVAC system piping thermowells required for Division 23 work and by the control system. Install thermowells in accessible locations, to allow for visual observation of control devices, and to allow for proper control system operation.
- C. Tubing: Provide all control tubing necessary to properly connect all control devices (e.g. differential pressure sensors, gauges, etc.).
- D. Control Dampers: Install all control dampers furnished by Division 25 and as necessary for proper functioning HVAC systems. Verify damper sizes, locations, orientation, accessibility, and other installation requirements.
- E. Control Valves: Install all control valves furnished by Division 25 and as necessary for proper functioning HVAC systems. Verify valve sizes, locations, porting arrangements, and other installation requirements. Provide unions at connections to valves (except not required on flanged valves).

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Natural Gas Piping.
- B. Natural Gas Valves.
- C. Natural Gas Regulators.
- D. Natural Gas Accessories.

1.03 SUBMITTALS

- A. General: Provide submittals in accordance with Section 23 05 00.
- B. Product Data: Submit manufacturer's product data for all items to be used.

1.04 REFERENCES

- A. ASME B 6.5: Steel Pipe Flanges and Flanged Fittings.
- B. ASME B16.9: Steel Butt - Welding Fittings.
- C. ASME B16.11: Forged Steel Fittings, Socket Welding and Threaded.
- D. ASTM A53: Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
- E. ASTM A105: Carbon Steel Forgings for Piping Applications.
- F. ASTM A234: Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- G. ASTM B88: Seamless Copper Water Tube.
- H. ASTM B280: Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- I. IFGC: International Fuel Gas Code.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. General: Products shall comply with Section 23 05 00. See Section 23 05 00, Paragraph 2.01 for Acceptable Manufacturer requirements.

- B. Pipe and Fittings: US Steel, Anvil International, Wheatland Tube, Weldbend, Exltube.
- C. Valves: Milwaukee, Flowserve (Nordstrom), Stockham, Conbraco/Apollo, Nibco, Resun, ASCO.
- D. Regulators: Fisher, American Meter, Equimeter.

2.02 PIPE AND FITTINGS - ABOVEGROUND

- A. Pipe: Black steel pipe conforming to ASTM A 53, Grade A or B, Type E or S. Schedule 40 unless indicated otherwise.
- B. Fittings:
 - 1. 2 Inches and Smaller - Exposed: Black malleable iron threaded type, Class 150 conforming to ASME B 16.3 and ASTM A 234.
 - 2. 2 Inches and Smaller - Concealed: Steel butt weld type, conforming to ASTM A 234, ASME B 16.9; or steel socket weld type, conforming to ASTM A 105 and ASME B 16.11.
 - 3. 2-1/2 Inches and Larger: Steel butt weld type, conforming to ASTM A 234, ASME B 16.9; or steel socket weld type, conforming to ASTM A 105 and ASME B 16.11.
 - 4. Flanges: Steel socket or welding neck type, Class 150, conforming to ASME B 16.5.
- C. Vent Pipe: Same as gas piping; except where routed exposed in mechanical rooms, may be hand drawn or annealed seamless copper conforming to ASTM B 280 or UNS number C12200 copper conforming to ASTM B 88, with wrought copper fittings, bronze fittings, and soldered joints.

2.03 VALVES

- A. General: Valves shall be designed for use on natural gas system and suitable for the pressures and temperatures to be encountered. Valves shall be UL listed (or CSA certified) for fuel gas use.
- B. Ball Valves: Bronze body, two piece body, blowout proof stem, full port, reinforced TFE seats, chrome plated brass ball, threaded connections, UL listed for LP gas and natural gas shut-off, 250 psi non-shock LP or natural gas working pressure. Nibco T-585-70-UL (or approved).

2.04 ACCESSORIES

- A. Piping Specialties: See Section 23 05 19.
- B. Pressure Regulator: Cast iron body, die cast aluminum alloy diaphragm case, Buna-N diaphragm disc, 125 psi maximum pressure rating with over pressure positive tight lock-up, internal relief valve, and gray polyester paint finish. Regulator shall be sized by manufacturer based on inlet pressure, desired outlet pressure, and flow requirements. Regulators with vent openings located within 20 feet of ventilation air intakes or where the venting of gas would be unsafe shall be equipped (and labeled for use with) a vent

limiting device.

- C. Flexible Connectors: See Section 23 05 19. Size flexible connectors to match pipe size shown on plan, with reducer after the flexible connector to match the equipment connection size.

PART 3 - EXECUTION

3.01 GENERAL

- A. General: Comply with Section 23 05 00. Install in accordance with manufacturer's written installation instructions, code, and best construction practices.
- B. Complete System: Provide all piping as indicated and as required to allow connections to all equipment requiring gas connections, and to provide complete and operational gas piping systems.
- C. Coordination: Coordinate installation of items with all trades that are affected by the work to avoid conflicts. Review all drawings for location of pipe spaces, ducts, electrical equipment, ceiling heights, door openings, window openings, and other details and report discrepancies or possible conflicts to Architect/Engineer before installing pipe.

3.02 PIPE AND FITTINGS

- A. General:
 - 1. All piping in finished areas shall be installed concealed unless specifically noted otherwise.
 - 2. Install piping at such heights and in such a manner so as not to obstruct any portion of windows doorways, passageways, or access to any items requiring routine service, maintenance, or inspection. Offset or reroute piping as required to clear any interferences which may occur.
 - 3. Install all piping parallel to the closest wall and in a neat, workmanlike manner. Horizontal exposed straight runs of piping shall not deviate from straight by more than 1/4-inch in ten feet. Vertical piping shall not deviate from plumb by more than 1/8-inch in ten feet.
- B. Electrical Items: Do not run any piping above electrical panels (and similar electrical equipment). Provide offsets around such panels as necessary. Such offsets are typically not shown on the plans, and are required per this paragraph.
- C. Joints: Prior to the joining of any section of pipe to a pipe run, the section shall be thoroughly cleaned inside and out, the ends shall be reamed to remove any cutting burrs and piping prepared as recommended by pipe and fitting manufacturer.
- D. Threaded Connections: Cut piping carefully, ream, thread and work into place without springing. Use TFE tape or lead and graphite lubricant (on male threads only).
- E. Welding: Shall conform to ASME B31.1 and ASME B31.9. Welders and welding operators shall be qualified as required by ASME B31.1, ASME B31.9, and governing code. Welded joints on piping system shall be continuous, without backing rings, and

pipe ends beveled for butt weld connections. Gas cuts shall be square and free from burned material. Before welding, surfaces shall be thoroughly cleaned. Piping shall be carefully aligned, with no weld material projecting inside the pipe.

- F. Unions: Install unions in pipe connections to equipment and other items where it may be necessary to disconnect the item from piping for repairs or maintenance; and as indicated. Where flanged connections occur at equipment additional unions are not required unless indicated otherwise.
- G. Equipment Drip Legs: Provide drip legs in pipe connections to all equipment. Drip legs shall be located downstream of equipment isolation valves, and upstream of unit flexible connectors or unions. Provide adequate clearance for removal of drip leg cap.
- H. Regulators: Provide drip legs with removable caps upstream of all regulators; provide test tee with capped valve 10 pipe diameter downstream of all regulators.
- I. Flexible Connectors: Provide flexible connectors in piping at connections to all equipment. Size flexible connectors to match pipe size shown on plan, with reducer after the flexible connector to match the equipment connection size. Install such that both ends of flex connectors are accessible.
- J. Vents: Pipe regulator vent lines and all equipment gas train vents full size to outside of building; terminate with vent cap.
- K. Outdoor Piping - Painting: All aboveground piping outside of building shall be cleaned and prime painted with one coat of a rust-inhibiting paint and a final coat of finish paint (color to match adjacent building color, unless noted otherwise).

3.03 VALVES AND ACCESSORIES

- A. Type: Ball type.
- B. Applications: Provide isolation valves at piping connections to all equipment, at inlet of all pressure regulators, at inlet of all seismic shut-off valves, downstream of gas meters, at inlet to gas solenoid valves, and where indicated.

3.04 TESTING AND INSPECTION

- A. General: All piping shall be tested, inspected, and approved by the AHJ prior to being concealed or covered.
- B. Witnessing: Testing shall be witnessed by the AHJ and the Architect/Engineer (at his option). Notify Architect/Engineer minimum 72 hours prior to date of testing, and mutually agree upon times arranged.
- C. Testing:
 - 1. Piping shall be inspected, purged and pressure tested in accordance with IFGC (except where more restrictive requirements are specified herein, the most restrictive shall prevail).
 - 2. Test pressure shall be not less than 150 percent of the maximum to which the pipe will ordinarily be subjected; but in no case less than 50 psig.

3. Components that may be damaged by the test pressure shall be removed or isolated from the piping system during testing.
 4. Portions of the system that are reconnected after system testing that could not be tested (e.g. low pressure equipment connections, separate portions of the system, etc.) shall be specifically tested with a non-corrosive leak detection fluid acceptable to the AHJ.
 5. Any leaks or defective piping disclosed by testing and inspection shall be repaired with new materials and the system re-tested.
- D. Documentation: Provide documentation to the Architect/Engineer indicating that the system has been completely pressure tested, and all portions inspected and accepted by the AHJ.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Chilled Water Piping.
- B. Valves.
- C. Balancing Valves.
- D. Air Vents.
- E. Flushing and Initial Testing.
- F. Chemical Cleaning, Treatment and Final Testing.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Submit product information data for all items.
- C. Shop Drawings: Submit shop drawings of underground piping system.
- D. System Flushing, Cleaning and Testing: Submit documentation of work performed.
- E. Water Treatment:
 - 1. Submit name and qualifications of Water Treatment Specialist and chemical product data.
 - 2. MSDS sheets for all chemicals.
 - 3. Submit Water Treatment Specialist report.
- F. Operation and Maintenance: Submit operation and maintenance data, submittal data, and Water Treatment Specialist report for inclusion in project O&M Manuals.

1.04 QUALITY ASSURANCE

- A. Water Treatment Specialists (WTS): Shall be a company regularly engaging in this work, having local representation and staff with at least 5 years experience, separate and independent from the system installers. WTS shall have staff trained and experienced in hydronic system chemistry and water treatment. WTS shall have water treatment research and laboratory services available for analyzing hydronic water systems and prescribing proven treatment systems.

1.05 REFERENCES

- A. ASME B16.3: Malleable Iron Threaded Fittings.
- B. ASME B16.15: Cast Bronze Threaded Fittings: Classes 125 and 250.
- C. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.
- D. ASME B18.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B18.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500.
- F. ASME B31.1: Power Piping.
- G. ASME B31.9: Building Service Piping.
- H. ASTM A 53: Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
- I. ASTM A 530: General Requirements for Specialized Carbon and Alloy Steel Pipe.
- J. ASTM B 16.18: Seamless Copper Water Tube.
- K. ASTM B 32: Solder Metal.
- L. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
- M. AWS A5.8: Filler Metals for Brazing and Braze Welding.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Pipe and Fittings: US Steel, Anvil International, Wheatland Tube, Weldbend, Exltube, Elkhart, CTS, Mueller, Cerro, Cambridge-Lee.
- C. Valves: Milwaukee, Nibco, Watts, Conbraco/Apollo, Stockham, Red-White.
- D. Balancing Valves: Bell & Gossett, Armstrong, Taco, Nibco, Red-White.
- E. Air Vents – Manual: Same as listed for valves.
- F. Air Vents – Automatic: Bell & Gossett, Hoffman.
- G. Chemicals: Hydrochem, Dow Chemical, Hercules Chemical Company, Rhomar Water Management, U.S. Water

2.02 PIPE AND FITTINGS – MATERIALS

- A. Steel Pipe and Fittings:

1. Pipe: Black steel pipe, per ASTM A 53, Type E or S, Grade A or B, Schedule 40 unless indicated otherwise.
 2. Fittings:
 - a. Threaded: Malleable iron fittings per ASME B16.3 or threaded cast iron fittings per ASME B16.1 or ASME B16.4.
 - b. Welded: Steel weld fittings per ASTM A 234; butt weld type per ASME B16.9; socket weld type per ASME B16.11.
 - c. Flanged: Fittings, bolts, nuts, and bolt patterns per ASME B16.5, Class 150. Flanges shall comply with ASTM A105. Bolts shall be high strength or intermediate strength, with material conforming to ASTM A193.
 3. Threads: Shall conform to ASME B1.20.1
 4. Coupled Piping Systems: See Section 23 21 15.
- B. Copper Pipe and Fittings:
1. Pipe: Seamless copper water tube, hard temper (unless noted otherwise), type K or L as indicated, per ASTM B88.
 2. Fittings:
 - a. Solder Joint: Wrought copper and bronze fittings per ASME B16.22 and cast copper alloy fittings per ASME B16.18, cast bronze threaded fittings per ASME B16.15.
 - b. Flanged: Cast bronze fittings per ASME B16.24.
 - c. Solder Material: 95/5 tin-antimony solder per ASTM B32 or "Silvabrite 100" (95.5 tin/4 copper/0.5 silver) solder; lead free.
 - d. Brazing Material: AWS A5.8, BCuP-5.
 3. Coupled Piping Systems: See Section 23 21 15.

2.03 PIPE AND FITTINGS – APPLICATIONS

- A. Chilled Water: Steel with threaded fittings on pipe 2 inch and smaller, flanged or welded on larger pipe sizes; or type L copper with soldered or brazed joints.
- B. Automatic Air Vent Drain Piping and Miscellaneous Drain Piping: Type L copper with soldered or brazed joints.

2.04 VALVES

- A. Ball Valves:
 1. 2 Inches and Smaller: 125 psi-swp bronze body, full port, 2 piece construction, anti-blowout stem, reinforced TFE seats, stainless steel or chrome plated brass ball, extended stem, cadmium plated steel lever handle with vinyl covering, solder

or threaded connections as required. Provide with extension stem for handle where valve is installed in systems with insulation thickness greater than 0.5 inch. Nibco S-585, T-585 (or approved).

2. 2-1/2 Inches and Larger:

- a. Stainless: Class 150 stainless steel body, split-body full bore design, anti-blowout stem, carbon filled TFE seats, stainless steel ball, stainless steel trim. Nibco F-515-S6-F-66-FS (or approved).
- b. Cast Iron: Class 125 cast iron body, split-body full port, anti-blowout stem, PTFE seats, stainless steel ball. Conbraco/Apollo IBV-125 Series (or approved).

B. Butterfly Valves:

- 1. 2-1/2 Inches and Larger: 200 psi non-shock cold water, ductile iron body, extended neck, molded-in seat EPDM liner, stainless steel stem, and aluminum bronze disc. Provided with lugs for dead-end service. Nibco LD-2000, WD-2000 (or approved).

C. Check Valves:

1. 2 Inches and Smaller:

- a. Horizontal: 125 psi-swp bronze body horizontal swing check valve, regarding type, y-pattern, renewable seat and disc, solder or threaded connection. Nibco S-413 or T-413 (or approved).
- b. Vertical: 125 psi-swp bronze body vertical inline check valve, stainless steel or bronze disk holder, Buna-N disk, stainless steel spring actuated, solder or threaded connection. Nibco S-480 or T-480 (or approved).

2. 2-1/2 Inches and Larger:

- a. Horizontal: 125 psi-swp iron body vertical inline "silent" check valve, wafer or flanged style, renewable seat and disk, stainless spring actuated, bronze disk. Nibco W-910 (or approved).
- b. Vertical: 125 psi-swp iron body vertical inline "silent" check valve, wafer or flanged style, renewable seat and disk, stainless spring actuated, bronze disk. Nibco W-910, F-910 (or approved).

- D. Drain Valves: Bronze ball valve, minimum 125 psi-swp, anti-blowout stem, stainless steel or chrome plated brass ball, reinforced TFE seat, solder or threaded inlet connection, male 3/4 inch hose thread outlet connection, with brass cap and chain. Nibco S-585-70-HC, T-585-70-HC (or approved).

- E. Triple Duty Valve: Not allowed.

2.05 BALANCING VALVES

- A. Manual:

1. General: Valve shall have, as an integral factory manufactured part of the valve, ports which allow measurement of the pressure drop across the valve to determine the flow rate using factory calibrated pressure drop versus flow charts. Valve shall have a means to adjust the flow rate through the valve and shall have a numerical readout indicating valve position. Valve shall have a concealed locking memory stop feature which prevents opening the valve beyond its balanced setting. Locking position may be unlocked by use of a standard size allen wrench.
2. Construction: Rated 300 psig at 250 deg F, Y-pattern, globe type, constructed of brass copper alloy or ASTM A536 ductile iron, with EPDM O-ring seals. Handwheel controlling valve position shall be of plastic construction, containing readout of valve position.
3. Connections: Valves 2-1/2 inch and smaller shall have solder or threaded end connections; larger valves shall have flanged or grooved ends.
4. Sizing: Valve shall be same size as pipe installed in, except where required for proper flow measuring, valve may be one pipe size smaller.

2.06 AIR VENTS

- A. Automatic Air Vent - - High Capacity: Float type, with stainless steel float and float mechanism, cast iron body, rated for 250 psig maximum operating pressure, 300 degrees F. maximum temperature and 10 cfm capacity at 100 psig water pressure. Hoffman No. 792 (or approved).
- B. Automatic Air Vent: Float type, with stainless steel float and float mechanism, semi-steel or cast brass body, ball check preventing re-entry of air, rated for 150 psig maximum pressure and 250 degrees F. maximum temperature. Hoffman No. 78 (or approved).
- C. Manual Air Vent – Unfinished Areas: 1/4-inch, 125 psi bronze ball valve (Nibco S-589, T-580 or equal), with nipple connecting to pipe and discharge nipple and 1/4-inch diameter soft copper tubing, 24-inch long, provided.
- D. Manual Air Vent – Finished Areas: 1/4 inch, 125 psi bronze ball valve (Nibco S-589, T-580 or equal), with nipple connecting to pipe and discharge nipple with 1/4-inch male threaded outlet adaptor and cap.
- E. Coin Operated Air Vents: Manually operated air vent, suitable for 150 psig working pressure and 212 deg F maximum operating temperature, Bell & Gosset No. 4V.

2.07 CHEMICALS

- A. General: Chemicals shall be compatible with system materials and suitable for system operating conditions. Chemical shall be acceptable by local utility for discharge to sanitary sewer. Chemicals shall be delivered to the site in manufacturer's original sealed and labeled containers.
- B. Cleaner: Single liquid chemical product formulated for use as a cleaner in hot water heating and chilled water piping systems. Product shall have detergents, dispersants, alkaline emulsifiers, and additional agents to effectively remove grease, oil, dirt, mill scale and other contaminants from the piping systems. Cleaner shall be biodegradable. Rhomar "Hydro-Solv 9100" (or approved).

- C. Biocide: Broad spectrum microbiocide for use in hydronic piping systems.
- D. Corrosion Inhibitor: Liquid chemical product formulated for use in hot water heating and chilled water cooling systems to provide protection from corrosion. Shall be compatible with system heat exchanger and other materials (i.e. aluminum, stainless steel, or copper). Product shall be compatible with antifreeze, and all materials in the hydronic system that the product may come in contact with. For work on existing systems where portions of the existing system water will remain in the system use the same corrosion inhibitor type as currently in the system and compatible with the existing chemicals.
- E. Antifreeze: Industrially inhibited propylene glycol, formulated for use in hot water heating and chilled water cooling systems. Shall have operating range from -28 deg F to 325 deg F. Antifreeze shall contain corrosion inhibitors to prevent system corrosion. Product shall be dyed a bright color for easy leak identification. Reserve alkalinity shall be at least 15 to provide long term resistance to acidic pH. Dow "Dowfrost HD" (or approved).

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation: Installation of all items shall comply with code, best professional practices, and manufacturers written installation instructions.
- B. Complete System: Provide all piping as indicated and as required to allow complete supply and return connections to each item requiring hydronic service. Provide piping connections to equipment furnished by others in accordance with Section 23 05 00.
- C. Coordination: Coordinate installation of items with all trades that are affected by the work to avoid conflicts. Review all drawings for location of pipe spaces, ducts, electrical equipment, ceiling heights, door openings, window openings, and other details and report discrepancies or possible conflicts to Architect/Engineer before installing pipe.

3.02 PIPE AND FITTINGS

- A. General:
 - 1. Install piping at such heights and in such a manner so as not to obstruct any portion of windows doorways, passageways, or access to any items requiring routine service, maintenance, or inspection. Offset of reroute piping as required to clear any interferences which may occur.
 - 2. Install all piping parallel to the closest wall and in a neat, workmanlike manner. Horizontal exposed straight runs of piping shall not deviate from straight by more than 1/4-inch in ten feet. Vertical piping shall not deviate from plumb by more than 1/8-inch in ten feet.
 - 3. Use eccentric reducers for changes in pipe sizing, keeping the top of pipes in line.
- B. Insulation: Allow sufficient clearances for installation of pipe insulation in thickness specified. If interferences occur, reroute piping to accommodate insulation.

- C. Electrical Items: Do not run any piping above electrical panels (and similar electrical equipment). Provide offsets around such panels as necessary. Such offsets are typically not shown on the plans, and are required per this paragraph.
- D. Joints: Prior to the joining of any section of pipe to a pipe run, the section shall be thoroughly cleaned inside and out, the ends shall be reamed to remove any cutting burrs and piping prepared as recommended by pipe and fitting manufacturer.
- E. Threaded Connections: Cut piping carefully, ream, thread and work into place without springing. Use TFE tape or lead and graphite lubricant (on male threads only).
- F. Soldered and Brazed Connections: Polish contact surfaces of fittings and pipes with emery cloth before fluxing male and female surfaces of joints. Steel wool and sandpaper not permitted for polishing.
- G. Welding: Shall conform to ASME B31.1 and ASME B31.9. Welders and welding operators shall be qualified as required by ASME B31.1, ASME B31.9, and governing code. Welded joints on piping system shall be continuous, without backing rings, and pipe ends beveled for butt weld connections. Gas cuts shall be square and free from burned material. Before welding, surfaces shall be thoroughly cleaned. Piping shall be carefully aligned, with no weld material projecting inside the pipe.
- H. Unions: Install unions in pipe connections to valves, coils, and any other equipment where it may be necessary to disconnect the equipment or piping for repairs or maintenance; and as indicated. Where flanged connections occur at equipment additional unions are not required unless indicated otherwise.
- I. Insulating Unions: Install dielectric insulating unions or insulating type flexible connectors between all connections of copper piping and steel piping of steel equipment. Where flanged connections occur use insulating type flanges.
- J. Automatic Air Vents:
 - 1. Provide automatic air vents installed at each high point in the system, where air may become trapped, and where system is separated from other air vents by vertical drops or rises. Provide added automatic air vents where shown on drawings.
 - 2. All automatic air vents shall be connected to the system through a ball valve.
 - 3. All automatic air vents shall be provided with drain piping to the nearest funnel or floor drain. Multiple vents may be plumbed to a common drain line which then runs to the nearest funnel or floor drain. Such a drain system is not shown on the drawings (due to its incidental nature) but is a project requirement. Such drain line shall pitch toward nearest drain at a minimum 1% slope down and shall be the same size as the air vent connection size where serving 1 AAV, minimum 1/2-inch for serving up to 4 AAV's, 3/4-inch for serving up to 12 AAV's, and 1-inch where more are served.
- K. Manual Air Vents: Provide manual air vents where shown on the drawings and at each coil, except that automatic air vents shall be used where specifically called for on the drawings or where it is a high point in the system or where air may become trapped.

- L. Drains: Install drain valves at the low points in the piping system and at the base of each system riser. Provide additional drains as required to allow for complete draining of the system. These drain valves shall take off of the bottom of any horizontal pipe that they are connected to. Identify system drains on record drawings.
- M. Accessories: Install flow measuring devices, balancing valves, and related items per manufacturer's instructions; with the proper distances upstream and downstream to any pipe fittings.

3.03 VALVES

- A. General: Provide isolation valves as shown on the drawings. In addition to those shown, provide added valves to allow for the isolation of all individual equipment items.
- B. Type: Valves 2 inches and less shall be the ball type; larger valves may be ball or butterfly type at Contractor's option; except that valves indicated to be a specific type shall be the type as noted.
- C. Installation: Install valves so as to be easily accessible and oriented to permit ease of operation. Valve stem shall be directed toward operator in either the vertical or horizontal direction. Provide access doors for valves not otherwise accessible.
- E. Balancing Valves: Provide balancing valves in piping where indicated and where required to allow for equal distribution of water flows. Install in full open position unless noted otherwise.
- F. Check Valves: Check valves used on the discharge of pumps shall be the non-slam type (except for pumps 3/4 hp and less).

3.04 FLUSHING, TESTING, AND CHEMICAL TREATMENT

- A. General:
 - 1. Entire CHS/CHR piping system shall be flushed and pressure tested. The entire system is to be chemically treated to restore proper chemical levels.
 - 3. The activities specified herein represent the minimum work required; Provide additional work as necessary to suit unique aspects of the project (e.g. phased construction, long pipe runs, etc.) and as recommended by the Water Treatment Specialist (WTS) in order to provide clean, pressure tested, and chemically treated hydronic systems ready for service.
 - 4. Prior to beginning work have WTS confirm existing system treatment levels, conditions, and chemicals being used. Submit written report of condition and any adverse conditions discovered.
 - 5. System shall not be allowed to remain in a condition that is deleterious or aggravates corrosion. After being filled with water systems may not remain without chemical treatment for more than 48 hours; after having been filled and drained, systems may not remain empty for more than 24 hours. Provide added chemical treatment cycles during initial fill periods as needed to suit project phasing or extended testing/flushing periods.

6. Provide clear, accurate, and readable pressure gauges to ensure accurate pressure testing. Make a written record of the gauge readings, time, date, and where connected to the system and mark this information on site as-builts.
- B. Sequence: Work shall occur in the following order:
1. Prepare system for work.
 3. Flushing (includes strainer blow-down).
 4. Fill and leak testing.
 5. Chemical treatment.
- C. Preparation: Prepare system for flushing and testing. Isolate from the piping any parts of the system or equipment that may be damaged by the test pressure or entrapment of debris during the flushing process, or that are not part of the flushing process. Verify all system valves are in the required positions. Install any required (or recommended) start-up strainer screens or related items to protect components or to aid the flushing process.
- D. Flushing and Cleaning:
1. Flush system to remove system of debris. Use clean water or existing system hydronic water. Blow-down all strainers that are part of system being flushed. Open system valves (where possible) and other components to ensure full flushing. Provide temporary fill and drain piping as necessary. Provide sufficient number of drain points to ensure that all parts of the new piping are flushed.
 2. Clean new portions of work by circulating through the system a cleaning chemical. Use concentration, flow rates, and duration as recommended by the chemical supplier and WTS.
- E. Fill and Leak Test: Fill portions of the system to be flushed with clean water. Open local air vents and valves to allow filling. Check system for leaks during filling. Pressurize system to at least 20% above what system will experience during flushing process (but not less than 75 psig) and check for leaks. Any leaks shall be repaired and the system re-filled and re-checked until system proves tight. Provide temporary hose and piping as necessary.
- F. Final Testing: After flushing, drain the initial fill water from the portions undergoing flushing. Apply hydrostatic test to the system. Test pressure on systems with all new components only, shall be 125 psig; test pressure on portions with new and existing shall be 75 psig (unless noted otherwise). Confirm all test pressures with Engineer prior to test. System shall hold the test pressure for a minimum of 2 hours with no drop in pressure. Any leaks shall be repaired and the system re-tested until system proves tight.
- G. Documentation: Document all flushing, testing, and strainer cleaning. Documentation shall indicate when these tasks were conducted, description of the extent/scope of work, who did the work, and be signed by the person performing the work or the person supervising the work.
- H. Supervision: All work shall be performed under the direct supervision of the Water Treatment Specialist (WTS) subject to approval by the Architect/Engineer.

- I. Chemical Treatment: After successfully proven free of leaks, add corrosion inhibitor to the system to achieve pre-project chemical levels, or to a concentration of 100-150 ppm for molybdate inhibitors and 800-1200 ppm for nitrite inhibitors where pre-project chemical levels are not documented. Provide anti-freeze [where noted; provide] to 20% concentration by volume (unless noted otherwise). Existing chemically treated water drained from the system may be re-introduced into the system provided the water is filtered through a 20 mesh strainer and shows no signs of degradation and is acceptable to the WTS.
- J. Final Chemical Testing: Test system as recommended by the WTS to confirm proper system cleaning and stability. Test as a minimum for: total dissolved solids, pH, soluble iron, soluble copper, antifreeze percentage (as applicable), and concentration of corrosion inhibitor.
- K. Report: The WTS shall submit a report describing the initial system condition, final chemical test results, and the final condition of the system. Report shall include when testing work was performed, and name of individuals doing the testing work or supervising the work.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Mechanically Coupled Pipe.
- B. Mechanically Coupled Pipe Fittings.
- C. Mechanical Couplings.
- D. Mechanically Coupled Valves.
- E. Mechanically Coupled Piping Specialties.

1.03 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data: Submit product information on all pipe, pipe fittings, valves, and specialty products proposed to be used. Indicate gasket materials and coupling types to be used for each system and pressure/temperature limitations of all products.
- C. System Expansion/Contraction: Submit information indicating how system expansion/contraction will be accommodated. Provide plans with locations and details of all expansion joints, loops, anchors, guides, and other system features.

1.04 GENERAL REQUIREMENTS

- A. Contractor Option: The Contractor, at his option, may use mechanically coupled pipe, pipe fittings, valves and piping specialties in lieu of those materials otherwise specified. Only the valve and specialty items specifically called out in this specification section may be used.
- B. Systems: Mechanically coupled piping products are approved for use on the following only: Chilled Water Piping System.
- C. Standardization: All mechanically coupled piping products shall be of one manufacturer.
- D. Quality: All mechanically coupled piping products shall be equal to or superior than the otherwise specified product (i.e. if standard threaded, welded or flanged items were used). Mechanically coupled piping products shall only be used where the operating conditions do not exceed the design parameters of the gasket and product, and where system operation/performance is not adversely affected. The use of mechanically coupled piping products does not eliminate the requirement to provide other components indicated on the plans (i.e. flex connectors, expansion devices, etc.). Product manufacturer shall be ISO-9001 certified.

- E. Costs: Contractor shall bear all added costs of using mechanically coupled piping products in lieu of otherwise specified products.
- F. Tools: Tools used in grooving pipes and in assembling mechanically coupled system components shall be approved for such use by the mechanical coupled product manufacturer.

1.05 QUALITY ASSURANCE

- A. Domestic Manufacturing: Major components (piping, fittings, couplings, and valves, exclusive of minor hardware) shall be made in the United States of America, and shall permanently be marked as such.

1.06 REFERENCES

- A. ASTM A53: Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- B. ASTM A183: Carbon Steel Track Bolts and Nuts.
- C. ASTM A234: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel.
- D. ASTM A449: Quenched and Tempered Steel Bolts and Studs.
- E. ASTM A536: Ductile Iron Castings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Pipe: See system specification sections.
- C. Mechanically Coupled Piping Products: Victaulic Company of America, Anvil International, ("Gruvlock").

2.02 PIPE AND FITTINGS

- A. Pipe: See system specification sections.
 - 1. Pipe shall be roll/cut grooved in accordance with the latest manufacturer's recommendations.
 - 2. Pipe ends shall be free from indentations, projections, and roll marks.
- B. Fittings:
 - 1. General: Fittings shall be full flow type, with grooves, shoulders and other provisions for use with mechanical couplings by the same manufacturer as the fitting. Shall be products as indicated in the manufacturer's latest catalog literature.

2. Steel Piping Systems: Fittings shall be constructed of malleable iron conforming to ASTM A47, ductile iron conforming to ASTM A536, segmentally welded schedule 40 steel pipe conforming to ASTM A53 (type F, E or S, Grade B), or forged steel conforming to ASTM A234, (Grade WPB). Fittings shall be factory coated with an orange colored alkyd enamel paint; except where piping system is galvanized the fitting shall be hot dipped galvanized (conforming to ASTM A153).
3. Copper Piping Systems: Fittings shall be constructed of copper, conforming to ASTM B-75 alloy C12200 or ASTM B-152 alloy C11000, up through 4 inch size; or conforming to ASTM B-584, copper alloy CDA 836, 5 inch and larger. Fittings shall be factory coated with a copper colored alkyd enamel paint.

2.03 MECHANICAL COUPLINGS

A. Coupling Components:

1. Coupling housings shall be malleable iron conforming to ASTM A47 or ductile iron conforming to ASTM A536; hot dip galvanized per ASTM A153 where the connecting piping or fittings are galvanized.
2. Couplings shall be factory coated with an alkyd enamel paint; copper colored for fittings used on copper piping systems and orange colored for other systems.
3. Bolts shall be carbon steel track type conforming to ASTM A183 Grade 2, or ASTM A449; minimum tensile 110,000 psi. Nuts shall be hex style, conforming to ASTM A183 Grade 2, or ASTM A563 Grade A. Bolts and nuts shall be zinc electroplated to ASTM B633.
4. Gaskets shall be grade "E" EPDM conforming to ASTM D2000 Grade 2, with temperature range from -30 degrees F to +230 degrees F. Gasket selection for each system shall be in accordance with latest manufacturer's recommendations and so as to suit system pressures, temperatures and chemicals.

B. Couplings:

1. Steel Piping Systems: Couplings shall be equal to those manufactured by Victaulic, Styles 77, 177, 72, 750, and 107, or approved.
 - a. Victaulic Style 77, 177, 72, W77 and 750 coupling (or approved) shall be used to provide allowance for controlled pipe movement expansion/contraction/deflection to absorb movement for thermal changes, settling or seismic action.
 - b. Victaulic Style 107 "Zero Flex" W07 rigid coupling (or approved) with angular bolt pads shall be used for all pipe joint connections where joint flexibility is not desired.
2. Copper Piping Systems: Couplings shall be equal to those manufactured by Victaulic, Style 607. Coupling housings shall be cast with angular bolt pads.

2.04 VALVES

A. Butterfly Valves:

1. Shall have housing cast of ductile iron conforming to ASTM A-536, or malleable iron conforming to ASTM A-47, with grooved ends and shall be coated with a black alkyd enamel or epoxy coating or polyphenylene sulfide (PPS). Disc shall be of ductile iron construction, conforming to ASTM A-536, with electroless nickel coating conforming to ASTM B-733, or with grade "E" EPDM coating. Disc seat shall be pressure responsive elastomer, "E" EPDM. Stem shall be Type 416 stainless steel. Valve shall be rated for bubble-tight shut-off service up to 300 psi; vacuum service up to 29.9 inches of mercury; and for dead-end service. Provide valves with extended necks where used on insulated piping to allow for insulation without inhibiting valve operation. Victaulic "Vic-300, MasterSeal-W761" (or approved).
 2. Operator: Manual lever lock/ininitely variable handle with memory stop. Shall be fabricated of ductile iron, with painted enamel finish, and steel zinc plated fasteners. On valves 5-inch and larger, provide with manual gear operator with round handwheel.
 3. Alternative Valves: Other valves having equal pressure capabilities and of like construction to the above may be used with the Engineer's approval prior to bidding.
- B. Check Valves: Body shall be constructed of ductile iron conforming to ASTM A-536 and ASTM A-395, with grooved ends. Disc shall be aluminum bronze conforming to ASTM B-148 or ductile iron conforming to A-536, or Type 304 stainless steel; with spring assist. Body shall be coated with a black alkyd enamel or epoxy coating or polyphenylene sulfide (PPS). Spring shall be constructed of Type 316 stainless steel. Seal shall be grade "E" EPDM with temperature range -30 degrees F to +230 degrees F continuous service, and be rated for up to 300 psi working pressure. Valve shall be operational when installed in horizontal or vertical positions, and shall close off tight with as low as 5' of head on discharge side. Victaulic Series 716/779 W716 (or approved).
- C. Balancing Valves:
1. General: Valve shall have, as an integral factory manufactured part of the valve, ports which allow measurement of the pressure drop across the valve to determine the flow rate using factory calibrated pressure drop versus flow charts. Valve shall have a means to adjust the flow rate through the valve and shall have a numerical readout indicating valve position. Valve shall have a concealed locking memory stop feature which prevents opening the valve beyond its balanced setting. Locking position may be unlocked by use of a standard size Allen wrench. Victaulic/TA Hydronics Series 786, 787, 788, or 789 (or approved).
 2. Construction: Rated 300 psig at 250 deg F, Y-pattern, globe type, constructed of brass copper alloy or ASTM A536 ductile iron, with EPDM O-ring seals. Handwheel controlling valve position shall be of plastic construction, containing readout of valve position.
 3. Connections: Valves 2-1/2 inch and smaller shall have solder or threaded end connections; larger valves shall have flanged or grooved ends.
 4. Sizing: Valve shall be same size as pipe installed in, except where required for proper flow measuring, valve may be one pipe size smaller.

2.05 PIPING SPECIALTIES

- A. Suction Diffuser: Body shall be constructed of ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47. The combination diffuser-strainer-orifice cylinder shall be of Type 304 stainless steel with 5/32-inch or 3/16-inch diameter holes. Start-up pre-filter shall be stainless steel (or bronze), 20 or 16 mesh screen. Rated for 300 psi working pressure at 250 deg F. Provide with 1-1/4-inch pipe support boss, bottom drain plug and side gauge tap. Victaulic 731-D/W731 (or approved).
- B. Strainer: "T" or "Y" type configuration. Body shall be constructed of ductile iron conforming to ASTM A536 and ASTM A395 or malleable iron conforming to ASTM A47. Body shall be coated with an alkyd enamel or epoxy coating or polyphenylene sulfide (PPS). Screen shall be removable by removing end cap coupling. Screen shall be basket type, constructed of Type 304 stainless steel, 6 mesh. End cap shall have NPT blow-down connection, minimum 1/2-inch, and utilize manufacturers standard coupling style and gasket matching other couplings used in the system. Strainer Cv shall be no less than the nominal strainer diameter squared times 26. Rated for 300 psi working pressure at 250 deg F. Victaulic style 730/W730 (or approved).
- C. Branch Outlets: Victaulic Style 923 "Vic-Let", Style 924 "Vic-O-Well", Victaulic Style 920 and 920N "Mechanical-T" outlets (or approved); rated for 300 psi working pressure at 230 deg F.
- D. Dielectric Connection: Victaulic Style 47 "Clearflow Dielectric Waterway" fitting (or approved). Constructed of steel or ductile iron pipe, with zinc electroplating and internal thermoplastic lining. Rated for 300 psi working pressure at 230 deg F.
- E. Adapter Connection: Conversion of flanged outlets to mechanically coupled system connection shall be accomplished by Victaulic Styles 741 Flange Adapter (or approved), conforming to ANSI Class 125/150 bolt pattern, or Style 743 Flange Adapter (or approved), conforming to ANSI Class 250/300 bolt pattern.
- F. Flanged Adapter Nipples: Victaulic Style 41, 45, 46 (or approved) for connecting ANSI class 125, 150, and 300 flanged components to mechanically coupled piping system connection. Nipples shall be constructed of carbon steel pipe (same schedule as the piping system being connected); flanges of cast iron or carbon steel construction.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install all components according to the manufacturer's written installation instructions and applicable codes and standards. See piping system specification section for piping and system installation requirements.
- B. Pipe Preparation: Piping shall be prepared in strict accordance with the coupling manufacturer's instructions and ANSI/AWWA C-606.
- C. Coupling Fasteners: Torque as required by manufacturer. Demonstrate equipment used upon Engineer's request.
- D. Dielectric Connection: Provide dielectric at all piping connections between dissimilar metals and equipment to protect from local cell corrosion.
- E. Coupling Types: Couplings that allow for system flexibility and expansion/contraction

shall be used except where a rigid coupled system is specifically required.

- F. Manufacturer's Review: Coupling manufacturer's factory representative shall periodically visit the project site and review the mechanical coupled products and installation and confirm compliance with the manufacturer's installation instructions.
- G. System Expansion/Contraction:
 - 1. "Flexible" Coupled Systems: Install piping ends with proper clearances ("pre-gap") to allow for system expansion (or contraction), as appropriate to temperatures at the time of installation and system operating temperatures and pressures. Provide pipe anchors at the end of pipe runs and intermediate guides to allow the gap between piping ends to take up piping expansion/contraction. Provide additional couplings (or expansion joints) to accommodate all pipe movement without excessive pipe stress or angular deflection in piping mains and branch connections.
 - 2. "Rigid" Coupled Systems: Provide expansions joints and expansion loops (or changes in piping direction) to accommodate system expansion and contraction. Provide pipe anchors at the end of pipe runs and intermediate guides to allow piping to expand/contract into the installed expansion device/system.
 - 3. The system features to accommodate all system expansion and contraction shall be Contractor selected, subject to review by the Engineer. Contractor's methods shall be based on guidance from the coupling manufacturer and engineering principles.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. In-Line Pumps.

1.03 SUBMITTALS

- A. Product Data: Provide product information and performance data for all pumps. Performance data shall include pump curves, showing pump performance as head vs. GPM, BHP and NPSH vs. GPM, with system operating point clearly marked. (NPSH vs. GPM not required for pumps 1 HP and less.)
- B. Installation: Submit manufacturers installation instructions for pumps.

1.04 QUALITY ASSURANCE

- A. Factory Testing: All pumps shall be factory tested per the Hydraulic Institute Standards and be thoroughly cleaned.
- B. Electrical: Coordinate pump electrical voltage/phase with Division 26 prior to ordering.

1.05 REFERENCES

- A. Hydraulic Institute Standards: ANSI/HI Pump Standards, Version 3.1.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00. See Section 23 05 00, paragraph 2.01 for Acceptable Manufacturer requirements.
- B. In-Line Pumps: Bell & Gossett, Armstrong, Taco.

2.02 GENERAL

- A. Balancing: All rotating parts shall have been statically and dynamically balanced at the factory.
- B. Alignment: Pump and motors shall be factory aligned, and have alignment checked and reset once installed in place.
- C. RPM: Pumps and motors shall operate at 1750 rpm unless indicated otherwise.
- D. Pump Capacity: Shall be no less than the values listed on the Mechanical Equipment

Schedule on the drawings.

- E. Pump Types: The type of each pump is indicated on the Mechanical Equipment Schedule under the "Type" column, and corresponds to the types specified herein.
- F. Motors: Shall comply with Section 20 05 00. Motors shall be of sufficient size so as to be non-overloading at any point on the operating curve and shall be no smaller than the size shown on the drawings. Motors shall be of drip-proof construction (unless indicated otherwise), resilient mounted with oil lubricated journal or ball bearings, and have built-in thermal overload protectors. Motors shall be for use with the voltage and phase as indicated on the drawings.
- G. Finish: Pumps shall have minimum one coat high grade machinery enamel finish, factory applied, manufacturer's standard color.
- H. Nameplate: Pumps shall have nameplates identifying: manufacturer, model number, capacity (gpm and head), and date of manufacturer.
- I. Variable Speed Application: Pumps used with variable speed drives shall have motors that are compatible with the variable frequency drive unit and shall have suitable couplings and accessories to suit variable speed duty.
- J. Coupling Guards: Provide pumps with coupling guards complying with OSHA requirements.
- K. Pump Seal Replacement: If pumps are used for any Hydronic System Flushing or Cleaning (see hydronic piping system specifications), Contractor shall replace pump seals when flushing/cleaning is complete.

2.03 VERTICAL IN-LINE PUMPS

- A. Type: Centrifugal, single stage, split coupled, in-line pump with vertical shaft. Bell & Gossett Series 80-SC (or approved).
- B. Operating Range: Pump shall be rated for continuous operation at a minimum 175 psi and 250°F.
- C. Volute: Cast iron or ductile iron construction (except shall be of bronze construction where pump is noted as "all bronze"), with plugged gauge tappings at inlet and outlet, and plugged vent and drain tappings at top and bottom. Shall have flanged suction and discharge connections, pressure class to match piping system connected to.
- D. Impeller: Cast bronze, fully enclosed, keyed to shaft and secured with stainless steel locknut. Impeller key and hardware shall be of stainless steel construction.
- E. Shaft: Type 416 stainless steel, guided by a carbon graphite throttle bushing. Shaft shall be coupled to motor with a split rigid spacer type coupling, with slotted coupler guard.
- F. Seal: Internally self-flushing mechanical seal; with EPR or EPDM or Viton elastomer, carbon rotating face, tungsten carbide (or silicon carbide) stationary face, stainless steel spring, and metal parts of stainless steel or brass construction.
- G. Service: Pump seal shall be replaceable without removing pump motor or disturbing piping connections.

- H. Support: Provide all floor supported vertical shaft pumps with a cast iron pump stand designed for attachment to pump to provide substantial support off the floor.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with Section 23 05 00. Install in accordance with manufacturer's written installation instructions, code, applicable standards and best construction practices. Install pumps at locations indicated and in accordance with Contract Documents.
- B. Piping: Decrease from line size to pump inlet size with long radius reducing elbows and minimum 5-pipe diameter straight pipe into pump (except where suction diffusers are used) and out of pump. Where reducers in the horizontal are used on pumps, they shall be the eccentric type installed with taper on the bottom.
- C. Flexible Connectors: Provide flexible connectors in piping to pumps and where indicated.
- D. Alignment: Check motor alignment after pump installation; re-align as necessary.
- E. Owner Instruction: Instruct Owner on equipment operation, including: system start-up, shut-down, emergency shut-down, normal control operation, safety aspects, maintenance and repair instructions. Comply with Section 23 05 00.

3.02 START-UP

- A. Pre Start-Up Inspection: Inspect equipment and connecting systems to confirm equipment and connecting systems, and to confirm equipment has been installed properly and is ready for start-up. As a minimum, check for: proper voltage and phases, correct electrical connections, correct pump rotation, and other items as listed by the manufacturer are properly provided/connected and operating to ensure safe and proper start-up. Install in accordance with manufacturer's written instructions, code, applicable standards and best construction practices. Care shall be taken when moving and setting units not to damage roof, curb, units, or other items.
- B. Start-Up: Perform start-up in accordance with manufacturers written start-up procedures. Arrange other trades needed to be present (i.e. balancer, control technician, etc.). Check pump operation to ensure that specified flows are provided, without motor unloading or pump cavitation. Notify the Architect/Engineer of any unusual conditions or performance other than as specified.
- C. Adjustments: Adjust and set unit components to allow for proper operation (i.e. adjust fan sheaves, adjust fan speeds, unit settings, etc.). Observe unit to detect any unusual vibration, leakage, loose wiring, or other situations that could affect unit operation.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Environmental Ductwork Systems.
- B. Flexible Duct.
- C. Acoustical Duct Lining.
- D. Preparation of Duct for Service.

1.03 DEFINITIONS

- A. Duct Sizes: All duct dimensions shown are inside clear dimensions. Where inside duct lining is specified or indicated, duct dimensions are to the inside face of lining.
- B. Environmental Ductwork Systems: Ductwork systems that are not covered by Section 23 35 00 - Special Exhaust Systems.

1.04 QUALITY ASSURANCE

- A. All work and materials shall comply with SMACNA-DCS, NAIMA-DLS, ASHRAE-F, IBC, IMC, NFPA-90A, NFPA-90B, and code. The most restrictive criteria governs.
- B. Leakage Criteria: Duct system shall be constructed and sealed so that leakage does not exceed 5%.
- C. Fabrication Proximity: The Contractor performing the work of this section shall have fabricating facilities located within 100 miles of the project site.
- D. Drawing Review: Prior to beginning any work review all drawings, duct routing, duct connections, equipment configuration, equipment connection locations, and other work details to discover conflicts in anticipated duct arrangement and improper or incomplete connections. Review shall include the following: supply ducts not connected into return (or exhaust) ducts, ducts not crossed and improperly connected in shafts, air outlets/inlets connected to ducts, unit configuration compatible with planned duct connections, louver locations match architectural plans. Submit resolutions of such possible conflicts as submittals with shop drawings of proposed solutions; written description in lieu of shop drawings is acceptable for minor issues.

1.05 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Submit product data for duct lining, flexible duct, and factory fabricated items.

- C. Shop Drawings: Submit shop drawings for all HVAC ductwork which is to be installed differently than as shown on the drawings.

1.06 DUCT PRESSURE CLASS

- A. Constant Volume Systems: Ductwork shall be constructed to the pressure class corresponding to 1.2 times the static pressure indicated for the fan which serves the duct system (plus or minus as appropriate); unless noted otherwise. (For example, a fan designed to operate at 1-inch wc static pressure would require 2-inch pressure class duct construction as $1\text{-inch} \times 1.2 = 1.2\text{-inch}$; 2-inch is therefore the required pressure class.)

1.07 REFERENCES

- A. ADC-FLEX: Air Diffusion Council Flexible Duct Performance and Installation Standards.
- B. ASHRAE-F: ASHRAE Handbook of Fundamentals.
- C. ASTM A 653: Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
- D. ASTM A 924: General Requirements for Steel Sheet Metallic-Coated by the Hot-Dip Process.
- E. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. IMC: International Mechanical Code.
- G. NAIMA-DLS: North American Insulation Manufacturers Association Fibrous Duct Liner Standards, 1st Edition.
- H. NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.
- I. NFPA 90B: Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- J. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.
- K. UL 181: Underwriter Laboratories Factory-Made Air Ducts and Air Connectors.
- L. UL 181A: Underwriter Laboratories Closure Systems for Use with Rigid Air Ducts.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Sheet Metal: All domestic manufacturers.
- C. Spin-in Fittings and ATTO: Sheet Metal Connectors Inc., United McGill, Royal Metal Products, Airflow Products Inc.

- D. Gasketing: Preson, Insulfab, Duraco.
- E. Duct Sealant and Tape: Carlisle (Hardcast), Ductmate, Benjamin Foster, Grace Construction Products, United McGill, Polymer Adhesives Sealant Systems, RCD Corporation, Nashua, 3M.
- F. Acoustical Duct Lining: Johns-Manville.

2.02 GENERAL MATERIALS

- A. Ducts: Construct of galvanized sheet steel, suitable for lock forming without flaking or cracking, conforming to ASTM A653 and A924, having a zinc coating of 0.90 ounces total per square foot for both sides of a sheet, corresponding to coating G90.
- B. Fasteners: Steel construction, electroplated zinc coated, having strength properties adequate for the application, compatible with materials being joined, and in accordance with SMACNA-DCS. Where exposed to corrosive conditions shall be of Type 304 or 316 stainless steel. Type to meet duct pressure class and duct leakage requirements. Where used for the support and anchorage of ducts shall comply with Section 20 05 29, with independent test reports regarding strength.
- C. Spin-in Fittings: Factory fabricated of galvanized steel with die-formed mounting groove and damper with raised damper quadrant where ducts are to be insulated. Collar length for flexible duct attachment shall be at least 2" long.
- D. Air-Tight Take-Off Fittings (ATTO): Factory fabricated branch duct connector, of galvanized steel. Flange shall be 1-1/2" wide with 1/8" self-adhesive gasket and pre-drilled fastener holes. Collar length for flexible duct attachment shall be at least 2" long. Where used on round duct mains, shall be saddle type appropriately sized for main duct diameter.
- E. Draw Bands:
 - 1. Metal: Worm gear type clamp, constructed of galvanized steel, stainless steel, or aluminum; minimum 1/2-inch wide band; suitable for 200 pound loading.
 - 2. Non-Metal: Nylon "zip-tie" with self-locking ability, designed for flexible duct usage, minimum 1/4 inch wide, rated for 175 pound load, suitable for temperatures from 0 to 185 deg F; listed per UL181B and labeled "UL181B-C".
- F. Gasketing: Vinyl nitrile, vinyl neoprene, or neoprene nitrile PVC blend; designed for HVAC use with size to suit the application having minimum 1.5-inch width at equipment roof curb applications. Fire hazard rating not to exceed 25 for flame spread and 50 for smoke development per ASTM E 84.
- G. Duct Sealant/Mastic: Water based duct sealant, listed per UL 181B-M and UL 181A-M, suitable for indoor and outdoor use. Fire resistant with a flame spread rating of 5 or less, and a smoke developed rating of 0. Sealant shall be resistant to ultraviolet radiation and ozone. Fiberglass mesh shall be minimum 0.006-inches thick, with minimum 9 x 9 weaves per inch, and 2-inch width; for use with mastic in sealing ductwork. Sealant system shall be suitable for duct system pressure class and materials used with. Carlisle Hardcast "Versa-Grip 181".
- H. Foil Tape: Foil back adhesive tape, listed per UL181A-P and UL181B-FX, with listing

labeled on tape outer foil face. Minimum 3-inch width for metal-to-metal applications; minimum 2-inch width for flexible duct applications. 3M No. 3340 or Nashua No. 324A.

2.03 DUCT FABRICATION

- A. Duct Gauge and Reinforcement: Shall be as shown in SMACNA-DCS according to the pressure classification of the system and the duct dimensions; with heavier gauge duct used as required to minimize duct reinforcement to suit space available and other project constraints. In no case shall ducts be constructed of less than 26 gauge material.
- B. Joints and Seams: Construct in accordance with SMACNA -DCS, code requirements, and these specifications (more stringent governs). Ducts shall be constructed and sealed so that the leakage criteria is not exceeded. Round ducts shall be the spiral seam type; except that branch ducts to individual air inlets/outlets less than 16" diameter may be of other types as allowed by SMACNA-DCS. Coordinate joint spacing with duct reinforcement requirements so that transverse joints having the required stiffness may be incorporated in the reinforcement spacing schedule. Round duct transverse joints shall be made with beaded sleeve joints or flanged connections in accordance with SMACNA-DCS; except that branch ducts to individual air inlets/outlets less than 16" diameter may use other joining methods as are allowed by SMACNA-DCS.
- C. Elbows and Tees: Shall be long-radius type with a center-line radius not less than 1-1/2 times the width or diameter of the duct. Where space does not permit the use of long-radius elbows, short-radius or square elbows with turning vanes may be used. Elbows in round duct systems with duct pressure class above 2-inches shall be stamped type, welded segmented type, or standing seam segmented type.
- D. Transitions: Increase duct sizes gradually. Transitions for diverging air flow shall be made with each side pitched out not more than 22.5 degrees. Transitions for converging air flow shall be made with each side pitched in not more than 30 degrees. Except that eccentric transitions for round to flat oval may have up to a 45 degree pitch.
- E. Branch Connections: Shall comply with SMACNA-DCS, and as required herein.
 - 1. Rectangular-to-Rectangular: Rectangular take-off with 45 degree angle on "inside" of take-off, minimum 4" length. Reference SMANCA-DCS Figure 4-6. Close corner openings.
 - 2. Rectangular-to-Round: Serving Branch Duct: Rectangular to round transition, with maximum degree pitch as specified for transitions. Rectangular end size shall have free area no less than round end. Rectangular connection to rectangular main shall be made as specified for "Rectangular-to-Rectangular" connections.
 - 3. Other Connections: In accordance with SMACNA-DCS and recognized professional practices.
- F. Ductmate Systems:
 - 1. Rectangular Duct: Transverse duct joints may be made with Ductmate System, or approved equal. System shall consist of companion flanges of 20 gauge galvanized steel with an integral polymer mastic seal; corner pieces of 12 gauge G90 galvanized steel; 20 gauge G90 galvanized cleats; closed cell, high density gasket type; and galvanized carriage bolts with hex nuts. The flanges shall be

securely fastened to the duct walls using self-drilling screws, rivets or spot welding. Fastener spacing shall be as recommended by the manufacturer for the size of duct and the pressure class. The raw duct ends shall be properly seated in the integral mastic seal. A continuous strip of gasket tape, size 1/4" x 3/4", shall be installed between the mating flanges of the companion angles at each transverse joint; and the joint shall be made up using 3/8-inch diameter x 1-inch long plated bolts and nuts. Galvanized drive-on or snap-on cleats shall be used at spacing recommended by the manufacturer.

G. Lined Ductwork:

1. Rectangular Ducts: Contractor Fabricated ductwork with interior duct lining. Duct fabrication and liner installation shall comply with NAIMA-DLS. Lining material shall comply with paragraph titled "Duct Lining" in this specification section.

2.04 DUCT LINING

- A. Material: Flexible, inorganic glass fiber material, bonded with thermosetting resin, maximum thermal conductivity of 0.24 Btu-inch/hr-sq. ft.-degree F at 75 degrees F, coated to prevent erosion, conforming to NAIMA-DLS and exceeding that standard as specified herein. Suitable for air temperatures to 250 degrees F, and duct velocities to 6000 feet per minute. Surface shall be coated with an acrylic coating having anti-microbial agents and factory applied edge coating. Johns-Manville "Permacote Linacoustic" (or approved).
- B. Thickness: Lining shall be 1-inch thick except where noted otherwise.
- C. Adhesives and Fasteners: Shall conform to NAIMA-DLS, and as suitable for the duct liner material and ductwork.
- D. Fungi and Bacteria Resistance: Conform to ASTM C 1338 and ASTM G21 for fungi resistance and ASTM G 22 for bacteria resistance.

PART 3 - EXECUTION

3.01 DUCTWORK INSTALLATION

- A. General: Install all ductwork with all accessories and connections to provide complete and operable duct systems, in accordance with plans and specifications. See Section 20 05 29 for hangers and supports. Provide quality assurance review of all drawings prior to beginning work (see paragraph titled Quality Assurance, this specification Section and see Section 20 05 00). Provide duct and plenum sizes and locations as shown on the drawings; except as adjusted for field conditions and work of other trades, and with prior approval of the Engineer. See Section 20 05 00 for offsets and transitions to be included in project.
- B. Coordination: The Contractor shall fully coordinate the work of all trades to avoid interferences and conflicts. Due to the extremely tight spaces in portions of the building, the Contractor shall coordinate duct reinforcement spacing and supports with other trades as necessary to avoid interferences. In addition, the Contractor shall select duct gauge and reinforcement types to avoid interferences. Changes required due to lack of coordination between trades, improper spacing or selection of hangers, or improper duct

gauge and reinforcement selection, shall be done at no additional cost to the owner.

- C. Field Measurements: Prior to fabricating any duct materials, the Contractor shall field measure all areas where ducts will be installed to verify room available and all offsets and fittings required. Field verify connection sizes and locations to equipment, louvers, and similar items.
- D. Workmanship: All work shall comply with code, SMACNA-DCS, and other applicable standards. Ducts shall be installed level (unless noted otherwise) and in neat lines with the building construction using best professional practices.
- E. Exposed Ducts:
 - 1. All ducts are to be installed concealed unless indicated otherwise. Ducts that are exposed shall be carefully fabricated, stored, and installed for best appearance. All dents, dings, scratches and other damage shall be repaired for a high quality finished look; all dirt, debris, labels, stickers, lettering, and marks removed; and the duct completely cleaned. Any sealant shall be cleaned to form a straight and even seam adjacent to joints, have no overlap onto duct areas not needing sealant, and have all excess sealant removed (mask off adjacent areas as necessary).
- F. Spin-in Fittings/ATTO's: May be used for branch ducts to individual outlets only. Apply a bead of duct sealant to all spin-in fittings where fitting seals against sheet metal duct.
- G. Sealing:
 - 1. General: Use materials listed and approved for the specific application. Foil tape may only be used at duct connections to air inlets/outlets (unless specifically noted otherwise). Clean surfaces to be sealed of moisture and all contaminants. Seal joints in accordance with SMACNA-DCS, sealant manufacturer's instructions, and UL 181.
 - 2. Ductwork: Seal to meet duct leakage criteria as follows: Seal Class B.
- H. Ductmate: All "Ductmate" and similar systems shall be installed in strict accordance with manufacturer's instructions.
- I. Protective Caps: Provide temporary sheetmetal caps or heavy visqueen covers over all open portions of ductwork to prevent debris, dirt, and dust from entering the ductwork. Such covers shall be installed at the end of each work shift, and shall remain in place until all work activities or events that may cause duct contamination will no longer occur.

3.02 ACOUSTICAL DUCT LINING INSTALLATION

- A. General: Install acoustical duct lining in ducts to extent shown on drawings, covering all interior surfaces. Round ducts shall use factory fabricated double-wall ducts as specified.
- B. Installation: Installation shall comply with NAIMA-DLS and these specifications. The liner shall be cut to assure tightly butted joints.
- C. Liner Attachments: The duct liner shall be applied with a 100% coverage of adhesive. Mechanical Fasteners shall be installed flush with the liner surface, and shall be spaced in accordance NAIMA-DLS.

- D. Horizontal Duct Runs: Tops of ducts over 12" wide and sides of duct over 16" high shall have liner additionally secured with mechanical fasteners.
- E. Vertical Duct Runs: Any side of duct over 12" in size shall have liner additionally secured with mechanical fasteners.
- F. Exposed Edges: All joints, exposed edges and any damaged areas of the liner, shall be heavily coated with fire resistant adhesive/mastic.
- G. Metal Nosing: Install metal nosings on the leading edges of the liner in ducts where the velocity exceeds 4000 feet per minute.

3.03 PREPARATION FOR SERVICE

- A. Cleaning: All ducts shall be wiped or blown clean of all dust and debris prior to the installation of grilles or diffusers. Notify the Engineer to allow for an inspection prior to installing grilles or diffusers.
- B. Contaminated Ducts: Where ducts have been contaminated by dirt or debris during the construction process, the affected duct systems shall be cleaned by an independent firm specializing in the vacuum cleaning of ductwork. All costs associated with such cleaning shall be the responsibility of the Contractor.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Turning Vanes.
- B. Flexible Connectors.
- C. Duct Access Doors.

1.03 QUALITY ASSURANCE

- A. General: Comply with Section 23 05 00.
- B. Workmanship: Construction and installation of all duct accessories shall comply with applicable SMACNA-DCS, and exceed those standards as noted.

1.04 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data: Submit product information on all items to be used.

1.05 REFERENCES

- A. AMCA 500D: Laboratory Methods for Testing Dampers for Rating.
- B. SMACNA-DCS: SMACNA HVAC Duct Construction Standards, 3rd Edition.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Turning Vanes: Duro-Dyne, Aero-Dyne, Oil Capital Sheet Metal, Airsan.
- C. Flexible Connections: Ventfabrics, Duro-Dyne Elgen.
- D. Duct Access Doors: National Controlled Air, Ventfabrics, United-McGill, Kees, Ruskin, Vent Products, Duro-Dyne.
- E. Building Access Doors: J.R. Smith, Zurn, Acudor, Elmdoor, Kees, J.C. Industries, Milcor.

2.02 TURNING VANES

- A. Type: Galvanized steel turning vanes to guide airflow through duct elbows to minimize pressure drop.
- B. Construction: Turning vanes shall comply with SMACNA-DCS. Vanes shall be fabricated of minimum 26 gauge galvanized steel; rails shall be fabricated of minimum 24 gauge galvanized steel. For duct widths less than 12 inches, vanes may be single wall construction; for widths 12" and greater, vanes shall be double wall "airfoil" type.
- C. Spacing: Turning vanes shall be equally spaced in accordance with SMACNA-DCS, parallel to each other, and securely attached to runners.
- D. Unequal Elbows: For elbows where the inlet and outlet dimensions are not the same, modify vane shape or angle to provide optimum turning.

2.03 FLEXIBLE CONNECTORS

- A. Type: Flexible fabric type connectors, to provide vibration isolation at equipment duct connections and to allow for movement in duct systems.
- B. Fabric:
 - 1. Width: Minimum 3" wide except at equipment 3 hp or larger with external vibration isolators fabric shall be minimum 6" wide.
 - 2. Indoor Applications: Flexible woven glass fiber fabric with neoprene coating, minimum 22 oz/sq. yard, 500 lbs x 450 lbs tensile strength. Suitable for temperatures from -40 to 200 deg F.
 - 3. Outdoor Applications and Where Exposed to Chemicals: Flexible woven glass fiber fabric with hypalon coating, ozone resistant, 24 oz/sq. yard, 225 lbs x 300 lbs tensile strength. Suitable for temperatures from -40 to 250 deg F.
 - 4. High Temperature Applications: Fiberglass/satin weave with Teflon coating; temperature rating of minimum 500 deg F and to suit application, 400 lbs x 300 lbs tensile strength.
- C. Metal Collars: Minimum 24 gauge galvanized steel 3" wide metal edge connectors, each side of fabric, connected to fabric by folded over metal seam. Fabricate of same material as ducts connected to.
- D. Fire/Smoke Rating: Flame spread rating not over 25, and smoke developed rating not higher than 50; complying with IMC requirements and NFPA standards.

2.04 DUCT ACCESS DOORS

- A. Construction: Access doors shall be of double wall construction, made with minimum 24 gage galvanized steel, tight fitting, with sealing gasket, and cam locks (or may be hinged type with latches).
- B. Size:
 - 1. General: Access doors shall be of sufficient size so that items concealed in duct can be serviced and inspected, and shall be adequately sized to allow complete removal of the item being served (where removal cannot be made without

disturbing fixed ductwork).

2. Minimum size: Doors shall be minimum 14" x 14". Where duct size will not accommodate this size door, the doors shall be made as large as practicable.
 3. Large Sizes: Doors larger than 14" x 14" shall have a minimum of 4 cam locks (or where hinged type is used, have a minimum of two (2) latches).
- C. Insulation: Doors in insulated ducts shall be insulated type, with minimum 1 inch thick fiberglass insulation.
- D. Round Ducts: Access doors on round ducts shall use either lined rectangular tap off with rectangular access door or curved insulated access door (for insulated duct); or curved type un-insulated access door (for un-insulated duct).

2.05 BUILDING ACCESS DOORS

- A. Type: Hinged lockable steel access doors, for wall or ceiling installation.
- B. Construction: Minimum 16 gauge frame and 14 gauge door, concealed hinge, cam and cylinder lock, anchoring provisions, and 1" wide frame to conceal rough building opening. Provide of 18-8 stainless steel construction with No. 4 finish where used in restrooms, locker rooms, kitchens, and similar "wet" areas. Provide of steel construction with prime coated finish in other areas.
- C. Size: Size shall be 12" x 12" (unless indicated otherwise) but shall be large enough to allow necessary access to item being served and sized to allow removal of the item (where access door is the only means of removal without disturbing fixed construction).
- D. Fire Rating: Door shall maintain fire rating of element installed in; reference drawings for required rating.
- E. Keys: Access doors shall all be keyed alike. Provide two (2) keys for each door.

PART 3 - EXECUTION

3.01 TURNING VANES

- A. General: Install turning vanes in all duct elbows and "T" fittings, and at locations shown on the drawings.
- B. Attachment: Securely attach turning vane runners to ductwork.

3.02 FLEXIBLE CONNECTORS

- A. General: Provide flexible connectors at all duct connections to all equipment, where ducts of dissimilar metals are connected, and where shown on the drawings. Except that flexible connectors are not required on internally spring isolated fans where the fan is located in a separate mechanical room and a flexible connector has not been shown.
- B. Round: For round ducts, the flexible material may be secured by zinc-coated, iron clinch type draw bands directly to adjoining duct; or with normal duct joining methods and using metal collars furnished with flexible connectors.

- C. Slack: Install flexible connections with sufficient slack to permit 1 inch of horizontal or vertical movement of ducts or equipment at flexible connection point without stretching the flexible material. At building expansion joints install sufficient flexible material to allow for 2 inch movement in any direction; provide two flexible connectors separated by a 12 inch section of duct.
- D. Outdoors: Where installed exposed to outside weather, provide a galvanized "hat" channel protecting top and vertical stretches of flexible connector from sunlight and weather.

3.03 DUCT ACCESS DOORS

- A. General: Provide duct access doors at all automatic control dampers, fire dampers, fire/smoke dampers, smoke dampers, backdraft dampers, all duct coils, thermostats, filters, control devices, and any other components in the duct system that require service or inspection. Coordinate with Division 25 to confirm quantity and location of control devices.
- B. Size and Location: Access doors shall be of sufficient size and so located so that the concealed items may be serviced and inspected or completely removed and replaced.

3.04 BUILDING ACCESS DOORS

- A. General: Provide access doors in walls, floors, ceilings, etc. as indicated on the drawings and where needed to provide service access or maintenance to duct access doors, backdraft dampers, damper actuators, automatic dampers, coils, control devices, fans, HVAC equipment and similar items.
- B. Coordination: Consult architectural drawings and coordinate location and installation of access doors with trades which are affected by the installation.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Chiller
- B. Electric Heat Tracing
- C. Chiller Start-Up
- D. Owner Training and Instruction

1.03 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data: Submit product information on all products. Submit performance data for chiller unit, showing performance as a function of chilled water temperature and ambient temperature. Provide information showing chiller overall dimensions, service points and service clearances, and location of all chiller connections.

1.04 QUALITY ASSURANCE

- A. Ratings: Chiller performance shall be rated in accordance with AHRI standard 550/590. Unit performance and efficiency shall comply with code.
- B. Construction: Chiller construction shall be designed to conform to ANSI/ASHRAE 15, NEC, ASME standards, and code.
- C. Factory Test: Unit shall be operated and fully tested at the factory prior to shipment.
- D. Ambient Conditions: Unit and all components shall be able to withstand ambient temperatures from -10 deg F to 125 deg F, plus direct exposure to sun and weather elements. Unit shall be able to operate and produce chilled water between ambient temperatures of 50 deg F and 125 deg F.

1.05 WARRANTY

- A. One Year: Entire chiller shall be warranted by the manufacturer to be free of manufacturing defects for one year, in accordance with Division 00 and 01. All labor and materials associated with unit repairs shall be included in the warranty.
- B. Extended: Chiller compressors and refrigeration circuit and its components (piping, valves, accessories) shall be warranted by the manufacturer for an additional four years after the one year warranty (total of 5 years). All labor and materials associated with compressor replacement and refrigeration circuit repairs shall be included in the warranty.

1.06 REFERENCES

- A. ANSI/ASHRAE 15: Safety Standard for Refrigeration Systems.
- B. AHRI 550/590: Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle.
- C. ASTM B117: Salt Spray and Salt Fog Testing.
- D. ASTM 1654: Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00, Paragraph 2.01, Acceptable Manufacturers.
- B. Chiller – Base Bid: Trane, Carrier, JCI/York.
- C. Chiller – Alternate Bid: Smardt.
- D. Heat Trace: Ray-Chem.

2.02 PACKAGED OUTDOOR CHILLER

- A. Type:
 - 1. Base Bid: Packaged outdoor chiller with air cooled condenser and multiple rotary screw or scroll type compressors; for use with R-134A or R-410A or R-407C refrigerant.
 - 2. Alternate Bid: Packaged outdoor chiller as manufacture red by Smardt, with air cooled condenser and multiple oil-less compressors; for use with R-134A refrigerant.
- B. Capacity: Unit shall have a minimum cooling capacity as scheduled on the drawings at the conditions shown, certified to comply with AHRI performance and rating standards.
- C. Frame and Panels: Unit frame shall be one-piece welded assembly of minimum 14 gauge zinc coated steel. Unit panels and access doors shall be constructed of minimum 16 gauge zinc coated steel. Exterior surfaces shall be cleaned, phosphatized, and finished with electrostatically applied baked enamel finish, manufacturer's standard color, and yield an ASTM D1654 rating of 6 or better when subjected to a 1000 hour salt spray test per ASTM B117.
- D. Compressors, Motors, and Refrigeration Components:
 - 1. Compressors: Rotary screw scroll or oil-less type compressor, semi-hermetic type, direct drive, variable speed, differential refrigerant pressure oil flow and, oil heater. Unit shall have quantity of compressors scheduled.

2. Refrigeration Circuits: Unit shall have at least two independent refrigeration circuits. Each refrigeration circuit shall include expansion valve, replaceable core filter/drier, liquid line sight glass, liquid line shutoff valve, suction and discharge pressure gauges (each circuit) panel mounted with manual shutoff valves (gauges not required where system controls include pressure transducers and ability to visually display suction and discharge pressures at unit control panel). Unit shall be complete with proper operating charge of refrigerant and oil.
- E. Evaporator: Shell and tube design with seamless copper tubes roller expanded into tube sheets and with removable heads (or be of brazed plate stainless steel construction). Designed, tested and stamped in accordance with ASME Code for refrigerant side working pressure of no less than 350 psig and water-side working pressure shall be no less than 150 psig. Pressure drop shall not exceed the value scheduled on the drawings at the gpm shown. Each shell shall include drain connection, vent connection, bulbwells for low temperature controller, and 3/4" closed cell PVC foam insulation. Design shall accommodate required number of independent refrigeration circuits.
 - F. Condenser Fan and Motors: Shall be vertical discharge, direct-drive, propeller type. Fans shall be statically and dynamically balanced, with steel blades and zinc-plated steel hubs. Three-phase motors with permanently lubricated ball bearings, class B (or better) insulation, built-in current and thermal overload protection and weather tight slinger over shaft. Provide with PVC coated steel wire safety guards over fans.
 - G. Condenser Coil: Air cooled type, with aluminum fins mechanically bonded to seamless copper tubing. Unit shall have sub cooling circuit with liquid accumulator and be factory tested at 425 psig air pressure, vacuum dehydrated. Provide with louvered metal grilles for coil protection, PVC coated or with baked enamel finish same as specified for unit frame and panels.
 - H. Controls, Safeties, and Electrical:
 1. General: Unit shall have complete factory installed controls that allow for standalone unit operation. Controls shall be microprocessor based, and shall include all temperature and pressure sensors, printed circuit boards, wiring, raceway, power terminals, control circuit terminals, and accessories for proper operation. All unit controls shall be factory installed and tested. Controls shall regulate leaving chilled water temperature by automatic compressor sequencing, condenser fan sequencing, load limiting, and anti-recycle features. Controls shall maintain leaving water setpoint to plus or minus 1 deg F of setpoint. Unit shall consider return water temperature, leaving water temperature, and rate of change of these values to optimize compressor operation. Unit shall have controls to equalize run time between compressors. Controls shall limit compressor operation at start-up to prevent excessive electrical demand.
 2. EMCS Interface: Unit shall have a controller to interface with Division 25 and allow for the control and communication indicated; protocol used shall match the Division 25 control system. Unit shall have terminals (and associated controls) that allow for external remote enable/disable of the unit when these terminals are connected to each other (by the Division 25 control system). Unit shall have terminals (and associated controls) that allow for external remote reset of the unit's chilled water setpoint; such terminals shall accept a 4- 20 mA or 0-10 vdc signal (from the Division 25 control system) to accomplish this reset. Coordinate control connections and required signals with the Division 25 Contractor to ensure compatibility and to allow the sequence of operation specified herein and in Division 25.

3. Circuit Boards: Shall be protected to prevent RFI and voltage transient damage. Items requiring field wiring shall be factory wired to terminal strips to allow field termination at terminal strips and not at circuit boards.
 4. Ambient Protection: Unit controls shall be capable of withstanding the specified ambient temperature range without adverse effects, and shall be suitably enclosed to be protected from the weather, physical damage, and vandalism. Unit shall have ventilation fans, heaters, or other devices as necessary to allow components to withstand ambient conditions.
 5. Microprocessors: Memory shall be non-volatile type requiring no battery or capacitive back-up, while maintaining all data.
 6. On/Off/Auto: Provide unit with manual switch for local manual control (on/off) or automatic control (via EMCS enable).
 7. Digital Display: Provide with keypad, multi-character and multi-line liquid crystal display. Display shall allow full operator adjustment of unit and display of unit diagnostic information, operating status, setpoints, and control functions. Display shall be in clear English not requiring look-up of coded messages, and have at least two lines and 40 characters per line. Keypad shall be touch sensitive type, with minimum 16 keys. Access shall be able to be password protected to prevent changes by unauthorized personnel. Display shall indicated status of all connected control devices (e.g. temperature and pressure sensors, safeties) and be able to perform diagnostic to test operation of all control devices.
 8. Compressor Current Sensing: Unit shall have controls to allow measurement of amperage draw on each compressor, and be displayed at the unit's Digital Display, and provide an output to the building EMCS.
 9. Control Safeties: In addition to code required safeties, unit shall have safety controls to prevent operation that may damage the unit or be unsafe. Such safeties shall as a minimum include protections for the following conditions:
 - a. Loss of refrigerant charge.
 - b. Low water flow.
 - c. Low chilled water temperature.
 - d. Low and high superheat.
 - e. Low control voltage.
 - f. High refrigerant pressure.
 - g. Low oil pressure
 10. Low ambient controls: Unit shall have all necessary safeties and controls to allow operation at the specified ambient conditions.
- I. Electrical:
1. General: All power wiring shall be factory installed from unit power terminals to all unit devices requiring power. Provide all disconnects and fusing on internal

circuits as required by code.

2. Control Power: Unless indicated otherwise, provide unit with control transformer for powering unit controls, and all associated wiring and accessories.
3. Motor Electrical Overloads: Shall be through definite-purpose contactors and calibrated, ambient compensated, magnetic trip circuit breakers. Circuit breakers shall open all 3 phases in the event of an overload in any one phase (single-phasing condition).
4. Power Supply Monitor: Provide system to detect phase loss, phase reversal, phase imbalances, incorrect phase sequence, low line voltage, and similar adverse power conditions. System shall stop unit operation and indicate description of fault at unit Digital Display.
5. Power Disconnect: Provide unit with factory installed non-fused disconnect.
6. Starters: Where any compressor's running load amps exceed 100, the compressor shall have a wye-delta closed transition starter to reduce in-rush current on compressor start.
- J. Heater: Unit shall have internal thermostat controlled heater (or heat tape) to protect unit from freezing down to -20 deg F ambient temperature. Unless indicated otherwise, provide unit with control transformer for powering unit heater, and all associated wiring and accessories (unless indicated to be served by a separate power source).
- K. Flow Switch: Furnish with flow switch for field installation, NEMA 3R rated, with SPDT contacts. Provide chiller with terminal connections for wiring to flow switch to allow unit operation only when flow switch confirms flow.
- L. Vibration Isolators: Neoprene vibration isolation pads; See Section 23 05 48.

2.03 ELECTRICAL HEAT TRACING

- A. Type: Self-regulating electrical heat tracing cable to prevent pipeline freezing; UL listed. Raychem "XL-Trace" (or approved).
- B. Construction: Heater shall consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket. Heater shall be cable capable of being cut to desired length in the field.
- C. Voltage/Capacity: The heater shall operate on line voltages of 120, 208, 220, 240, or 277 volts without the use of transformers. See drawings for power source and voltage to be used for each application on this project. Heater shall have a minimum capacity of 5 watts/linear foot at 50 degrees F.
- D. Accessories: Provide the following accessories:
 1. Power Connection Kit: Shall include junction box, terminal connectors, and accessories allowing connection of power wiring to heater.
 2. Thermostat: Bulb type thermostat, with NEMA 4x enclosure, 3 foot capillary,

fixed setpoint of 40 degrees F. Provide with contactors (in NEMA 4x enclosures) as required to allow thermostat to control heater.

3. Tee/Splice/End Kits: Shall allow for connection of tee heater wiring, splicing connections, and end seal termination of heater.
4. Labels: Provide label reading, "Electric Traced", minimum one per 50 feet of heater. Locate labels at power connection kit location, end termination and other in-between locations as appropriate.
5. Tape: Fiberglass tape for attaching heater to pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install in accordance with manufacturer's written instructions, code, and best professional practices. Comply with Section 23 05 00.
- B. Locations: Install equipment at locations indicated and as shown on the drawings.
- C. Chiller Components: Connect and install all items shipped loose with units.
- D. Mounting: Provide concrete pad and supports at unit as indicated on the drawings. Set unit on specified vibration isolators. Anchor unit to isolators and isolators securely to concrete pad (or to building structure).
- E. Heat Tracing: Provide heat tracing of all piping, fitting/valves, and accessories at unit which carry water and are subject to freezing. Only items exterior of unit piping connections are to be heat traced. Heat tracing shall not be applied until after system has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape. Apply "electric traced" signs to the outside of the thermal insulation, subject heat to testing using a 100 VDC megger. Minimum insulation resistance should be 20 to 100 megohms regardless of length. See Division 26 for connection of power from panel to heat tracing power connection kit.

3.02 START-UP

- A. General: Start-up and subsequent system checks shall be done by the manufacturer's authorized service representative.
- B. Initial Checks: Prior to operating units, checks shall be made to insure that all equipment, piping, and controls are connected and operating properly. As a minimum, check for: proper voltage and phases, correct compressor oil level, valves open, pump operation and adequate water flow, correct electrical connections, complete control connections, overload heaters installed in compressor motor starters, all unit safety devices properly set and connected, unit heaters operational, condenser fans rotating correctly, fans lubricated, coils clear of obstructions, and other items as listed by the manufacturer are properly provided/connected and operating to insure safe and proper unit operation.
- C. 72 Hour Checks: Provide checks in accordance with manufacturer's instructions; as a minimum review the following:
 1. Observe the compressor oil level. If low, operate the system for three to four

hours, checking the oil level frequently. If it remains low, add oil.

2. Check the refrigerant flow in the liquid line sight glass. The flow should be solid with no evidence of flash gas. If bubbles of flash gas appear, check the system for leaks; repair if necessary and add refrigerant.
 3. Check the temperature of the liquid line from the inlet of the filter-drier to the expansion valve. The temperature should be uniform. If a decided temperature difference exists across a valve or fitting, a restriction is evident. The restriction is causing a pressure drop which, in turn, is causing the refrigerant to flash. Such a pressure drop produces bubbles of flash gas which will appear in the sight glass. Remove and clean the restricted part.
 4. Measure the superheat of the suction gas. If necessary, readjust the superheat setting of the expansion valve.
 5. Observe the system operating pressures.
 6. Clean all strainers in the chilled water circuits.
- D. One Week Check: After the system has been in full operation for one week, provide these final checks and adjustments: Observe the general operation of the system: system pressures, compressor oil level, liquid line sight glass, condensing equipment, etc.
- E. Written Report: When all of the above checks have been completed, a written report from the manufacturer's authorized service representative shall be provided. This report shall list all units checked, items checked, check results, any items which may impair proper unit operation, and the name and phone number of the actual individual(s) doing the check. The report shall include a statement stating whether or not all units are operating as specified. Separate data/record sheets shall be provided for each of the above units.

3.03 OWNER TRAINING AND INSTRUCTION

- A. After all testing and adjustments have been satisfactorily completed, the Owner shall be provided with operator instructions (including start-up, shut-down, emergency, maintenance, and repair instructions) by the manufacturer's authorized service representative. Training time may be scheduled to match weather conditions which allow the best review of system operation.
- B. Time Period: Instruction period shall be for a minimum of four (4) hours.
- C. Instruction and notification shall comply with Section 23 05 00.

3.04 END OF WARRANTY REVIEW

- A. General: Within 30 days of end of project warranty period, provide inspection and review of unit operation. Arrange mutually agreeable timing of review with Owner. Review shall be performed by the manufacturer's authorized service representative.
- B. Review: Observe unit operation and perform (as a minimum) the manufacturer's recommended annual service inspection.
- C. Written Report: Submit a written report of findings.

3.05 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Division 01 and Section 23 08 00. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Single Package Gas Heat/Electric Cool Units.
- B. Unit Roof Curbs.

1.03 SUBMITTALS

- A. General: Submittals shall comply with Section 23 05 00.
- B. Product Data: Submit product information on HVAC units, including performance data showing cooling capacity (as function of indoor and outdoor temperatures and airflow rates), heating capacity, fan performance, filter information, unit dimensions, required clearances, unit accessories, wiring diagram (distinguishing unit wiring from field wiring) and point of connection of all utilities.
- C. Installation: Submit unit installation instructions.

1.04 QUALITY ASSURANCE

- A. Listing: Units shall be UL listed and labeled.
- B. Performance Ratings: Units' cooling performance shall be rated in accordance with ANSI/AHRI 210/240. Units' heating performance shall be rated in accordance with ANSI/AHRI Z21.47.
- C. Codes: Unit and accessories shall conform to applicable codes and standards. Unit efficiency shall comply with code (and exceed code as indicated).
- D. Operating Ability: Unit and all components shall be able to withstand ambient temperatures from 0 deg F to 125 deg F, plus direct exposure to sun and weather elements without adverse affects. Unit shall be able to operate and produce cooled air between ambient temperatures of 45 deg F and 115 deg F. Unit shall be able to operate and produce heated air between ambient conditions of 0 deg F and 80 deg F. Unit shall be able to operate with supply air temperatures between 50 deg F and 125 deg F; and with room temperature setpoints between 65 deg F to 85 deg F.
- E. Electrical: Coordinate equipment electrical voltage/phase, minimum circuit amps, and overcurrent protection requirements with the Division 26 contractor prior to ordering.

1.05 GENERAL REQUIREMENTS

- A. Extended Warranties:

1. Unit compressors shall be warranted by the manufacturer for five years. All labor and materials associated with compressor replacement (or repair) shall be warranted.
2. Gas fired heat exchanger shall be warranted by the manufacturer for ten years. All labor and materials associated with heat exchanger replacement (or repair) shall be warranted.

1.06 REFERENCES

- A. ANSI/AHRI 210/240: Performance Rating of Unitary Air Conditioning & Air-Source Heat Pump Equipment.
- B. ANSI/AHRI 270: Sound Performance Rating of Outdoor Unitary Equipment.
- C. ANSI Z21.47: Gas Fired Central Furnaces.
- D. ANSI/ASHRAE 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- E. ASTM B117: Standard Practice for Operating Salt Spray Apparatus.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Products shall comply with Section 23 05 00. See Section 23 05 00, Paragraph 2.01 for Acceptable Manufacturer requirements.
- B. Units: Trane, Goodman.

2.02 SINGLE PACKAGED GAS HEATING/ELECTRIC COOLING UNITS

- A. General:
 1. Type: Single packaged outdoor gas heating and electric air conditioning unit. Configuration as shown on drawings.
 2. Factory Assembled Package: Units shall be fully factory assembled and shall be complete with casing, coils, fans, compressor(s), piping, wiring, disconnect, controls, gas burner, heat exchanger and all other accessories required to be ready for field connections and operation. Units shall be UL listed and labeled, and be designed for outdoor application.
 3. Capacity: Units shall have minimum cooling and heating capacities as scheduled on the drawings at the conditions shown.
 4. Refrigerant: Units shall be for use with refrigerant R-410A or R-407C, and shall be fully charged at the factory.
 5. Fuel: Unit shall be for use with natural gas.
- B. Unit Casing: Shall be constructed of zinc coated steel with baked on enamel finish. All exterior surfaces shall be cleaned, phosphatized, and finished with a weather resistant

baked-on enamel finish. Finish painted surfaces shall successfully pass 500 hours salt spray test in accordance with ASTM B117. Access panels shall provide access to unit controls, coils, fans, compressors, heating section, and all items requiring service. Access panels shall be easily removable, and be gasketed and insulated. Indoor air section shall be completely insulated with minimum 1/2" thick 1-1/2 lb. per cubic foot foil faced or neoprene coated fiberglass insulation, with cleanable foil faced insulation used at the evaporator section and burner heat exchanger section. All screws or holding devices shall be of cadmium plated construction to resist corrosion. Unit shall have knockouts for utility and control connections with rubber grommets to ensure water-proof connections. Casing below cooling coil shall have condensate drip pan constructed of non-corrosive material, sloped to drain, drain connection to outside, with PVC P-trap.

- C. Compressor(s): Direct drive hermetic, scroll type. Motor shall be suction gas cooled, and acceptable voltage range plus or minus 10% of unit nameplate voltage. Compressor shall have internal line break overcurrent protection and overtemperature protection, internal high pressure relief or high pressure switch, and crankcase heaters. Compressors shall be mounted on vibration isolators.
- D. Refrigerant Circuit: Shall be fully factory piped and shall include a refrigerant line filter/drier, service gauge ports, and thermostatic expansion valve or fixed orifice metering device.
- E. Evaporator and Condenser Coils: Shall be constructed of seamless copper tubing with aluminum fins mechanically bonded to tubes. Evaporator Coils shall be leak tested to 200 psig minimum; condenser coils shall be leak tested to 400 psig minimum.
- F. Fans:
 - 1. General: Fans shall be statically and dynamically balanced at factory.
 - 2. Evaporator Fan: Shall be forward curved centrifugal type, with belt drive or multi-speed direct drive motor. Motor shall be permanently lubricated type with built-in auto-reset thermal overload protection. Bearings shall be sealed, permanently lubricated type. Belt drive fans shall have quick adjust fan motor mounting plate or adjustable idler-arm assembly for easy belt tension adjustment. Sheaves shall be the adjustable type on belt driven units.
 - 3. Condenser Fan(s): Shall be propeller type, used in draw-through configuration. Fan shall be direct drive, with permanently lubricated totally enclosed weather-proof motor(s) having built-in auto-reset thermal overload protection.
 - 4. Adjustable Sheaves: All belt drive fans shall have adjustable sheaves (except where motors are 5 hp and larger, fixed sheaves may be used). Sheaves shall be selected so that they are at their midpoint at the design conditions.
- G. Heating Section: Shall be gas fired type, with heat exchanger to prevent products of combustion from coming into contact with heated supply air. Heat exchanger shall be constructed of corrosion resistant steel. Heater shall have induced draft or forced draft fans to vent products of combustion; fan shall be interlocked to unit's gas valve and heating controls to allow pre-purge of unit prior to opening gas valve and allowing combustion. Unit shall have code required safeties. Ignition shall be pilotless, and shall use electronic ignition or hot surface ignition system.
- H. Filters:

1. General: Units shall be provided with filter racks for accommodating 2" thick filters (unless noted otherwise), with minimum filter area (or sizes) as scheduled. Access panels to filters shall be hinged, with latches (or equivalent device) requiring no tools to open.
 2. Filter Type: Shall be pleated panel, disposable type. Filter shall have MERV 13 efficiency as evaluated by ASHRAE 52.2.
- I. Electrical Power: Units shall be for use with power of voltage and phase as scheduled on the drawings. Units shall have single source power entry unless indicated otherwise. Units with single source power entry shall require only one field connection and power source. All necessary terminal blocks, fuse blocks, fuses, wiring, junction boxes and accessories shall be factory installed within the unit cabinet to provide power to all unit devices requiring power. Access panels to unit electrical power section shall be hinged with latches (or equivalent device), requiring no tools to open.
- J. Economizer – Factory:
1. General: Unit shall have economizer system manufactured by unit manufacturer to allow use of 100% outside air for economizer cooling. System shall have outside air and return air dampers, each operable from 0% to 100% of unit total airflow capacity. Dampers shall have linkage to allow return air damper to close as outside air damper opens. Outside air inlet shall have an aluminum mesh water entrapment filter and intake hood.
 2. Relief: Unit shall have barometric relief damper to allow for pressure relief of building air when outside air damper is 100% open. Relief outlet shall have hood with birdscreen.
 3. Powered Exhaust: Where indicated on the plans, unit shall have powered exhaust with fan sized to exhaust no less than 80% of unit supply air. System shall include exhaust fan, exhaust hood, and exhaust fan, backdraft damper. Controls shall be configured to allow operation of fan by Division 25. Fans shall be direct drive centrifugal type, with permanently lubricated bearings and motor with thermal overloads.
- K. Controls:
1. General: Unit shall have factory installed controls which allow for the Division 25 control system to control unit fan, cooling, heating, and economizer operations. Unit shall be furnished with all necessary relays, starters, wiring terminal strips, timers, safety devices, interface modules, etc. to provide the sequence of operation as specified in Division 25 using the Division 25 control system, and allowing unit's safeties to protect unit components. Unit wiring shall be color coded and numbered corresponding to unit's wiring diagram. Access panels to unit controls shall be hinged with latches (or equivalent device) requiring no tools to open.
 2. Division 25 Interface: Unit shall have terminal strip (and associated controls) for connection of Division 25 wiring. Unit controls shall allow for:
 - a. Fan operation when "common" and "fan" terminals are interconnected (by the Division 25 control system). For units with variable speed fans, unit shall have control terminals to accept a 4 to 20 mA signal from the Division 25 control system to allow the Division 25 control system to control fan speed.

- b. Cooling operation when "common" and "compressor" terminals are connected (by the Division 25 control system). Provide "compressor 1", "compressor 2", etc. terminals to match number of compressor cooling stages for units with multiple stages of cooling.
 - c. Heating operation when "common" and "heater" terminals are connected (by the Division 25 control System). Provide "heater 1", "heater 2", etc. terminals to match number of heating stages for units with multiple stages of cooling. For units with modulating heat capability provide unit with terminals and controls to accept a 4 to 20 mA signal from the Division 25 control system to allow the Division 25 control system to control unit heating.
 - d. Economizer operation shall be by Division 25. Damper actuators and sensors shall be field installed on the unit by Division 25, and controlled by the Division 25 control system.
 - 3. Control Safeties: In addition to code required safeties, unit shall have safety controls to prevent operation that may be unsafe or damage the unit. Such safeties shall as a minimum include the following:
 - a. Heating: Pre-purge controls, proof of flame sensor, proof of combustion fan operation, and high temperature limit switch. Ignition system shall lock-out and require manual reset after 3 consecutive unsuccessful ignition attempts.
 - b. Cooling: Controls of all refrigeration system components, low refrigerant pressure safety, high refrigerant pressure safety.
 - 4. Ambient controls: Unit shall have all necessary safeties and controls to allow operation at the specified ambient and room conditions.
- L. Roof Curb: Factory fabricated heavy gauge steel curb, with horizontal base foot, top wood nailer wrapped over top with top of steel curb, and top gasket seal. Size, configuration, and capacity to match equipment served and roof slope installed on. Curb shall provide level watertight mounting surface for equipment served, and shall have provisions for seismic anchoring of unit to curb, and curb to building structure. Curb shall include seismic restraint reinforcing and calculations by a structural engineer licensed in the State of the project location showing forces imparted from the unit to the curb and from the curb to the roof structure as required by code and per requirements of Section 23 05 48.
- M. Accessories:
- 1. Gas Flue Extensions: Provide manufacturers standard or custom fabricated welded stainless steel flue gas extension extending 3 feet higher than top of unit (or as indicated on plans), with flue size matching unit size (or as recommended by manufacturer). Provide drain weep hole at bottom at connection to unit.
 - 2. Convenience Electrical Outlet: GFCI, 120V/15 Amp electrical outlet, for connection to power source separate from unit power. Outlet shall be mounted through unit cabinet, and have weatherproof hinged cover.
 - 3. Electrical: Through the base electrical power connection.

4. Circuit Breaker and Disconnect: Thermal magnetic, molded case, HACR circuit breaker, wired from circuit breaker to unit terminal block. Provide with water tight enclosure having exterior access through a hinged cover. Circuit breaker shall provide unit overcurrent protection and unit disconnect in accordance with NEC, UL, and code requirements. Shall be sized to properly handle unit electrical load, including power exhaust (where power exhaust is used).
5. Smoke Detector: Ionization or photoelectric type, with sampling tube (sized to match unit application), 2 sets form C contacts rated at 10 amps (115 VAC), 1 set form A contacts rated at 2 amps (30 VDC). For use with 115 VAC (or 24 VAC) power. Suitable for temperatures 32 deg F to 140 deg F, and air velocities up to 4,000 feet per minute. Unit shall be complete with plastic housing, clear plastic cover, gaskets, mounting hardware, visual indication of power and alarm, test/reset switch, and all accessories for proper operation. UL listed and complying with applicable codes and standards. Install in unit to sense return air (unless indicated otherwise).
6. Phase Monitor: Provide unit with 3-phase power monitor to monitor power to unit and stop unit operation upon phase loss, phase reversal, or phase unbalance, with auto reset, LED alarm indication and where indicated contacts for remote alarm indication.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with Section 23 05 00. Install in accordance with manufacturer's written instructions, code, applicable standards, and best construction practices. Care shall be taken when moving and setting units not to damage roof, curb, units, or other items.
- B. Location Verification: Install equipment at locations indicated in accordance with the Contract Documents. Prior to selecting unit installation locations and setting unit curb and unit, confirm that: unit curb properly matches building support structure; curb is level and dimensionally matches unit; installed duct locations match unit connection locations; manufacturer's pre-installation checklists have been completed; proper unit clearances and access will be provided; proper distances from plumbing vents and other vents; no adverse airflow conditions are present; and installation has been coordinated with other trades.
- C. Gasketing: Provide gasketing around top of unit curb and where duct connections mate to unit.
- D. Complete Connections: Connect and install all items shipped loose with units; provide and connect all utilities and accessories as required for proper unit operation.
- E. Refrigerant Charge: Units shall be checked for proper refrigerant charge and oil level and re-charged as necessary. Refrigerant shall be delivered to the site in factory charged containers and charged into the system through a filter/drier.
- F. Flue Extensions: Support rigidly from unit and so as to avoid transfer of heat and burning of paint on unit. Brace extension to accommodate wind forces.
- G. Cleaning: Units shall be thoroughly cleaned (internally and externally) of all debris prior to operation. Units shall be clean and in new condition prior to Owner acceptance.

- H. Owner Instruction: Instruct Owner on equipment operation, including: system start-up, shut-down, emergency shut-down, normal control operation, safety aspects, maintenance and repair instructions.

3.02 START-UP

- A. Pre Start-Up Inspection: Inspect equipment and connecting systems to confirm equipment and connecting systems have been installed properly and are ready for start-up. As a minimum, check for: proper voltage and phases, correct system refrigerant charge, correct electrical connections, complete control connections, all unit safety devices properly set and connected, heaters operational, fans free to rotate and rotating correctly, fans lubricated, belts tightened to proper tension, coils clear of obstructions, and other items as listed by the manufacturer are properly provided/connected and operating to ensure safe and proper start-up. If items are discovered that prevent start-up to be completed, notify the installing Contractor and Engineer of issues. Coordinate and re-schedule start-up after items are corrected.
- B. Start-Up: Perform start-up in accordance with manufacturers written start-up procedures. Coordinate with any other trades needed to be present (i.e. balancer, control technician, etc.). Operate equipment in various modes to confirm proper operation. Observe proper operation of all unit components (heating, cooling, condenser fan, economizer, etc.). Observe unit to detect any unusual vibration, leakage, loose wiring, or other situations that could affect unit operation.
- C. Adjustments: Adjust and set unit components to allow for proper operation (i.e. adjust fan sheaves, adjust fan speeds, unit settings, etc.).

END OF SECTION

DIVISION 25
INTEGRATED AUTOMATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 00 and 01 Specification sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 SECTION INCLUDES

- A. Control System Design.
- B. Complete Mechanical System Controls.
- C. Control Devices, Components, and Wiring.
- D. Control System Commissioning.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Product Data: Submit manufacturer's product data for all items to be used. Provide a complete materials list, labeled to match labeling used on shop drawing, with manufacturer and model number.
- C. Shop Drawings: Submit shop drawings of complete control system, including the following information: interconnect drawings showing all wiring and control connections, all control device locations, sequence of operation for all controlled systems, building floor plans with all proposed thermostat and other control device locations shown.

1.04 QUALITY ASSURANCE

- A. Skilled Workers: The entire control system shall be installed by skilled electricians, technicians, and programmers, all of whom are experienced, properly trained and qualified for the work they perform. Contractor shall submit evidence of workers' experience and training upon request of the Engineer.

1.05 GENERAL REQUIREMENTS

- A. Single Contractor: One single Company shall be responsible to design, furnish and install the complete Division 25 control system. Any subcontracted installation work shall be done by firms experienced and qualified in the work they perform, and subject to approval by the Engineer.
- B. Local Contractor: System shall be designed, programmed, and commissioned by local office personnel.
- C. Programming Point Names: Custom point naming is required to match the Owner's standard point naming scheme. Coordinate with Owner to confirm standards.
- D. Existing Systems:

1. Existing Controls: Existing controls are the DDC type, with controllers and other major components manufactured by Delta. New controls shall be the DDC type and shall be an extension and revision of the existing system; using components by the same manufacturer, with the same capabilities, and fully compatible with the existing system. Extend and revise system to include new equipment and items indicated. Revise and add system graphics to reflect all project work and to include new equipment and new items.
2. System Demolition and Revisions: Remove existing controls and revise control system as necessary so that existing items that remain continue to operate properly. Revise existing system graphics to reflect demolished portions of systems. Revise existing control wiring and control components as necessary to properly reconnect to all relocated and revised equipment so that the equipment and system operate properly. Revise and relocate existing wiring and control device locations to suit all revised areas.
3. Wiring and Component Reuse:
 - a. Existing controls materials may only be reused where specifically indicated.
 - b. Where indicated to be reused, verify existing system wiring and the details of the components to be reused; confirm they will operate properly with the new equipment and system revisions.
 - c. Existing components that are indicated to be reused shall be assumed to be in working condition (i.e. temperature sensors, relays, etc.) unless noted otherwise; however, Contractor shall review the operation and functionality of these items to confirm their condition and notify the Owner of any issues or component failure.
 - d. All reused items shall be cleaned, re-calibrated (where they have a calibration feature), and be adjusted/set for proper operation for the project.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. General: Products shall comply with Section 23 05 00.
- B. Control System Manufacturer: Delta.
- C. Other Control Components and Accessories: Idec, Hoffman, McDonnell, Tridelta, Veris, Kele, Edwards, Mamac, APC, Barksdale, Mark-Time, Functional Devices, and control system manufacturer listed.

2.02 BASIC SYSTEM

- A. General: The work involves revising the existing control system to accommodate project demolition, new HVAC equipment and related revisions. The system shall be a distributed processing type direct digital control (DDC) system same type as the existing. System shall provide complete stand-alone temperature control/monitoring and energy management for this project, using a network of various independent controllers, sensors and associated devices interconnected in a communicating network.

- B. System Protocol: Same as existing (Delta).
- C. Network: All controllers shall be interconnected in a communicating network to provide facility wide access to work stations and sharing of information. A Local Area Network (LAN) shall be provided to interconnect controllers for high speed data transmission. Failure of a single or multiple controllers shall not cause loss of communication between other LAN-connected controllers still active. The control system LAN shall be separate and independent from other building LAN's (except for a single data terminal connection at a single system workstation).
- D. System Performance:
 - 1. Graphics: System shall display a graphic with at least 20 dynamic points with all current data within 10 seconds of being initially displayed. System shall refresh a graphic with at least 20 dynamic points with all current data within 8 seconds.
 - 2. Object Command: Commands of a binary object entered at local workstations shall be executed at the commanded device within 2 seconds of being entered; analog objects shall start to adjust within 2 seconds.
 - 3. Current Data: Any data used or displayed at a controller or local workstation shall be current within the previous 6 seconds.
 - 4. Alarm Response: Maximum time between an alarm event at it being annunciated shall be 45 seconds.
 - 5. Program Execution Frequency: Applications shall be capable of running as often as every 5 seconds; select execution times that are consistent with the process under control and provide optimum comfort and control of setpoints without excess deviation. Controllers shall be able to execute PI and PID control loops at a selectable frequency of at least once per second; with the process value and algorithm output updated at this same frequency.
 - 6. Reporting Accuracy: Control system reporting end-to-end accuracy shall be no less than the following: Temperatures: Plus/minus 1 deg F.
 - 7. Stability: System shall provide stable and accurate control operation without excessive variation of controlled variables; variation shall in no case be more than 1.5 the reporting accuracy for temperatures, and the same as the reporting accuracy for other variables.

2.03 CONTROLLERS

- A. General: Shall be manufacturer's standard controllers used for commercial DDC systems similar to others currently used on this Owner's facilities. Controllers shall comply with the system communication protocol specified and allowing the system to provide the specified features and sequence of operation. Type, capacities, arrangement and features shall be Contractor selected to provide an overall system complying with Contract Document requirements.
- B. Terminal Unit Controllers (TUC's): Controller specifically designed for control of individual air handling units, fans, VAV terminal units, and similar type units; controllers shall be microprocessor based and shall contain a non-volatile resident program to allow for proper sequencing of controlled equipment. An individual controller shall be provided for each piece

of unique equipment. Each terminal controller shall be accessible for purposes of control and monitoring from a central or remote operator's terminal as specified herein.

2.04 TEMPERATURE SENSORS

- A. Room Temperature Sensors: Solid state electronic type, employing a resistance type output; similar to existing in use in the facility. Factory calibrated to an accuracy of plus/minus 0.5 deg F with a temperature range of 32 to 130 deg F in normally occupied areas and -40 to 140 deg F in other areas, with the following features:
 - 1. Space temperature display.
 - 2. Momentary push button for placing room's system into occupied mode when pressed.
 - 3. Means for adjusting temperature setpoint up or down with setpoint display.
 - 5. System fan/off indication.
 - 6. System heating or cooling mode indication.
- B. Room Temperature Sensor Guards: Lockable, slotted, clear plastic type.
- D. Duct Temperature Sensor: Shall be solid state electronic type, employing a resistance type output. Factory calibrated accuracy of plus/minus 0.5 deg F with a temperature range shall be -40 to 160 deg F. The sensor shall include a utility box and gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 5 foot long sensor element installed so as to sense a representative sample of the medium being controlled.
- E. Liquid Immersion Temperature Sensor: Shall be solid state electronic type, employing a resistance type output. Factory calibrated accuracy of plus/minus 1 deg F with a temperature range 0 to 250 deg F. Provide brass thermowells and install sensor probe with heat conductive grease. Probe and sensor head shall be removable without breaking fluid seal. Install sensors in top of pipe for horizontal runs and at a positive slope on vertical runs to prevent condensation from flowing to sensor head.
- F. Outside Air Temperature Sensor: Solid state electronic type device, for outdoor installation, factory calibrated accuracy of plus/minus 0.5 deg F, with a temperature range of -20 to 180 degrees F. Provide a sun shield and weatherproof assembly.

2.05 ACCESSORIES

- A. Wiring and Conduit:
 - 1. Basic Materials: As specified in Division 26.
 - 2. Power Wiring: 18 AWG minimum and rated for 300 VAC service. Wiring for circuits greater than 24 V shall be as specified in Division 26.
 - 3. Analog Signal Wiring: Field-installed analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG drain wire. Each wire shall have insulation rated for 300 VAC service. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape.

4. Life Safety Applications: Wiring that performs code required life safety control (e.g. shutdown of equipment), control of engineered smoke systems, fire alarm interface and similar functions shall comply with code and NFPA standards for fire alarm system wiring and the specific application.
- B. Labels:
1. General: Shall comply with Section 23 05 00.
 2. Control Devices: Labels on control devices shall use the same designation that appears on the control shop drawings and an indication as to purpose; except that devices in finished rooms shall be labeled as to the generic item controlled for better user understanding (i.e. "Room Exhaust Fan", "Hood Fan").
 3. Wiring: Wiring labels shall be the self-laminating or heat shrink type with numbering, lettering, or an alpha-numeric identifier indicating the wire signal/power purpose and matching the designation that is used on the control drawings.
- C. Control Cabinets: Wall mounted, NEMA rated construction, type and rating to suit location environment, UL listed, minimum 14 gauge sheet metal, hinged front door with latch. Size as required to house controls. Controls/devices shall be logically assembled in cabinet, with all devices and cabinet labeled.
- D. Relays/Contactors: Shall be the single coil electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contacts shall be doubled break silver to silver type protected by arching contact where necessary. Number of contacts and rating shall be selected for the application intended. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage. Relays shall have mechanical switching to allow manual operation of relay and LED light to indicate the energized state.
- E. Thermowells: See Section 22 09 00.
- F. Miscellaneous Sensors/Transmitters/Switches/Transformers: Shall be manufacturer's standard, designed for application in commercial building HVAC control systems, compatible with other components so as to provide sequence of operation specified.

2.06 SWITCHES

- A. Current Monitoring Switches: Electric current sensing device with integral switching contacts. Device shall sense current (amperage) through the conductor the device is applied to and activate switch action (to make and break contacts) once current reaches a preset value. Device shall be able to be clamped around conductor, and be removable. Switch rating, size, switching current, and type selected by Contractor to suit application and provide the required function. Provide type specifically rated for the motor and load type being applied to.
- B. Air Flow Switches: General Purpose utilizing differential air pressure, SPDT snap-acting contacts, adjustable 0.1in. W.C. to 2.0 in. (minimum), neoprene diaphragm, all aluminum construction.
- C. Water Flow Switches: General purpose liquid flow switch, SPDT snap-acting contacts, adjustable, neoprene diaphragm, in a dust-tight enclosure, rated 150 psig and 250°F.

- D. Bypass Switch: Shall be momentary contact type push button. Install in standard wall box with stainless steel cover.

2.07 CARBON DIOXIDE SENSOR – DUCT

- A. Type: Duct mounted non-dispersive infrared (NDIR) type carbon dioxide sensor. Vaisala GMD20 (or approved).
- B. Performance: Measuring range 0 to 2000 ppm CO₂, accuracy plus or minus 3% of reading (including repeatability and calibration uncertainties), non-linearity plus or minus 1% of full scale. Shall have long term stability of 5 years (i.e. no more than 5% of full scale error after 5 year operation).
- C. Housing: Plastic housing, with enclosure and accessories for mounting to duct and obtaining sample gas airstream.
- D. Output: Shall provide 4 to 20 mA, 0 to 20 mA, and 0 to 10V outputs, selectable by output selection jumpers.
- E. Display: Provide with liquid crystal display showing CO₂ ppm reading.

2.08 VARIABLE FREQUENCY DRIVES

- A. Type: Adjustable frequency and voltage variable speed controller, pulse width modulated type.
- B. Controller: Shall be housed in a NEMA 1 (or better) enclosure, and shall provide 6 to 60 Hz adjustable torque output. Standard Features:
 - 1. Start-stop speed selection.
 - 2. Manual speed potentiometer.
 - 3. Input fuses.
 - 4. Insensitive to incoming power phase sequence.
 - 5. Adjustable volts/Hertz.
 - 6. Output frequency stabilized to + 0.5% of set speed for +10% to -5% change in line voltage of 15 degrees C change in ambient temperature.
 - 7. Three-phase output voltage regulated to + 1% of rated voltage with +10% to -5% variations in plant power.
 - 8. Standard off-the-shelf, NEMA B and synchronous motors (3600, 1800, 1200 rpm) usable without derating controller.
 - 9. Automatic shutoff under output short circuit conditions or when load current exceeds 150% of maximum output amps (RMS).
 - 10. Input fuses.

11. Line transient protection to prevent power line transients from harming the controller.
12. Relay contact to provide external signal for alarm and run condition.*
13. Monitor lamps (or LCD display) indicating: power on, zero speed, enabled, unit failure (with type indicated).
14. Hand-Off-Auto switch.
15. Auto restart after power outage.
16. Isolated Process control Follower - accepts 0 to 5 mA, 1 to 5 mA, 4 to 20 mA, 10 to 50 mA, 0 to 10 V D-C or 25 to 250 V D-C signal.
17. Input Disconnect (meeting NEC requirements for unit power disconnect).
18. Output Contactor - for positive motor disconnect.
19. Output Overloads - using individual phase bimetallic thermal sensors.
20. Ammeter - ampere scale depending upon drive rating.*
21. Voltmeter - 0 to 500 volt (460 volt drives); 0 to 750 volts (575 volt drives).*
22. Frequency Meter - 0 to 120 Hz scale.
23. Manual Bypass - To switch the motor to or from the controller to the line.*

* Not required on units serving fans under 2 hp.

- C. VFD shall be for use with specified equipment. Unit shall accept appropriate control signal and provide for variable speed operation of unit served.
- D. System shall be fully compatible with motors furnished, and shall be free of audible noise exceeding an NC of 45 in any octave band.
- E. Basic Control Inputs/Outputs: Unit shall accept 4-20 mA control signal and provide for variable speed control of unit served. Unit shall have dry contacts that when connected enable VFD to operate, secondary dry contacts for emergency stop function, dry contacts for alarm output.
- F. Motor Compatibility: System shall be fully compatible with motors furnished, and shall be free of audible noise exceeding an NC of 45 in any octave band.
- G. Outdoor Enclosure: Wall (or floor) mount style, NEMA rating to suit application (NEMA 3R or better), constructed of minimum 16 gauge stainless steel with hinged front door with lockable latch. Size as required to house VFD with suitable clearances. Enclosure shall be fan ventilated and heated to maintain suitable conditions for proper VFD operation with ambient temperatures of 10 deg F to 95 deg F and with exposure to direct sunlight. Provide electrical wiring, controls, devices, and overcurrent protection so that no additional power circuits are required for fan and heater operation.
- H. Network Communications:

1. VFD shall include the following communication as standard without additional card. BACnet I/P, Modbus TCP, Modbus RTU, BACnet MS/TP. Drive shall be BTL listed to Revision 14 or later.
2. The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - a. Data Sharing: Read Property Multiple-B, Write Property Multiple-B, COV-B.
 - b. Device Management: Time Synchronization-B.
 - c. Object Type Support: MSV, Loop.
3. The drive's relay output status, digital input status, analog input/output values, Hand-Auto status, warning and fault information shall be capable of being monitored over the network. The drive's start/stop command, speed reference command, relay outputs and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.

PART 3- EXECUTION

3.01 INSTALLATION

- A. General: Provide complete control system design, all computer software and hardware, operator input/output devices, sensors, relays, switches, dampers, actuators, conduit, tubing, wiring, motor starters, transformers, control cabinets, power panel circuit breakers, and all other components required to provide a complete control system with the system features and sequence of operation specified. Select control components with proper characteristics to suit the application, meet specified system performance, provide specified system features, and provide the specified sequence of operation. Coordinate work with other trades. Review as-builts and field conditions for work involving existing systems or replacements of existing systems. Develop as-builts of existing systems as needed to perform the Work. Perform field reviews prior to developing shop drawings.
- B. Room Sensors: Room sensors (i.e. thermostats) shall be mounted at 48" above finished floor, unless indicated otherwise. Thermostats shall control the equipment which affects the temperature serving the space the thermostat is located in, unless indicated otherwise. Not all room sensors are shown on the drawings and those shown are preliminary only. Contractor shall indicate all final room sensor locations on submittal drawings. Contractor is responsible for coordinating locations to avoid chalkboards, tack boards and other interferences.
- C. Electrical Power and Wiring:
 1. General: All work shall comply with code and Division 26 requirements. Run conduit and wiring in neat lines, parallel with building construction and coordinated with other trades. Use wire type and size as required by code and recommended by component manufacturers and to suit the application conditions.
 2. Conduit: All wiring shall be installed in conduit and in accordance with Division 26 section of these specifications, except that low voltage wiring within ceiling plenum spaces and in mechanical mezzanine areas may be ran without conduit provided

that plenum rated cable is used. Install all conduit and wiring parallel to building lines.

3. Electrical Power:

- a. Scope: It is the responsibility of the Division 25 Contractor to provide power for all control devices requiring electrical power. Coordinate with the Division 26 Contractor to confirm which panels and circuits are to be utilized. Provide all electrical wiring, conduit, junction boxes, circuit breakers, grounding, panel circuit breakers (of proper size/type), transformers, enclosures and all other components as needed to power all control devices in accordance with code and Division 26 requirements.
- b. Sources: Power for control devices shall be obtained from electrical panels and not from power serving the equipment (unless noted otherwise or the Engineer gives approval). Utilize panels located closest to the items served to the greatest extent possible. Where the building has a generator, equipment served by the generator shall also have their control power (i.e. power to control devices which allow the item to be controlled and monitored) shall also be served by the generator (this is in addition to any required UPS').

4. Service Loop: Provide minimum of 6" extra wiring at all wiring terminations for ease of future maintenance/servicing. Such extra wiring shall be neatly coiled/bundled to allow for uncoiling when the connected equipment is serviced.

D. Equipment Interconnect Wiring:

1. General: In addition to control wiring between equipment and control devices (furnished under this Section) to accomplish the specified sequence, provide added control wiring to interconnect equipment components and associated control/safety devices. Provide as required by the equipment manufacturers to allow for proper operation of the equipment and system.
2. Minimal Wiring Required: For bidding purposes, assume a minimum of four wiring connections for each piece of equipment to an adjoining/connecting piece of equipment and/or device(s), and special wire type and special connectors as required by the equipment manufacturer. Coordinate and review all requirements with manufacturers, contractor installing the equipment, and local representatives to confirm scope. Field review existing conditions where controls interface with existing components.
3. Equipment: This work applies to: Chillers: Connect between chillers and devices for field installation in the chilled water system (includes flow switch and temperature sensors).

- E. Labeling: All control components, except regular room thermostats, shall be labeled. All control wiring shall be labeled except where color coded wiring is used and the control shop drawings clearly identifier wiring for each color and it is fully consistent through-out the entire project. Submit list of proposed labeling prior to installing.

- F. Complete Functions: Provide complete system totally programmed to provide all specified functions, including but not limited to:

1. Time and Holiday Schedules.

2. Alarm Limits.
 3. Optimum Start of Each Zone.
 4. Dynamic Graphic of Each Distinct Floor Area; include graphic key to allow changes in graphic display.
 5. Dynamic Graphic of Each Mechanical System; include graphic key to allow changes in graphic display.
 6. Summary of All Zone Temperatures.
 7. Summary of Data for Each Zone.
 8. All Displays Specified in Sequence of Operation.
 9. Master Menu and Graphics as requested by the Owner.
 10. All Controller Setpoints and Operational Values Required.
 11. Demand Limiting.
 12. Optimum Start/Stop and Warm-up.
- G. Electrical Phase Loss: Provide all necessary wiring, components, software, and accessories to monitor building electrical power quality and 3-phase power; initiate shutdown of 3-phase powered mechanical equipment on loss of a phase.
- H. On/Off Status Indication: All devices which indicate on/off status to GUI, shall have this on/off status manually or automatically controlled from GUI, and shall have positive proof of on or off by differential pressure switch or other applicable device.
- I. Time Clock Bypass Switch: Provide integral with each room sensor. Provide additional ones as indicated on the plans and where room sensor is not accessible. Bypass switch shall serve unit that supplies space in which bypass switch is located. Activation of by pass switch shall put unit(s) bypassed into the occupied mode as well as all equipment interlocked with the bypassed units. bypass shall be for 2 hours, but shall be adjustable in 30 minute increments at the GUI.
- J. TUC: To simplify controls and mechanical service and trouble-shooting, the TUC shall be mounted inside a waterproof cabinet on the side of rooftop units. This shall allow all controls maintenance and trouble-shooting to be made while at the unit location.
- K. Programming: Provide complete system totally programmed to provide all specified sequences, monitoring data, communications and features.
- L. CO2 Sensors: Duct mounted type, installed in the return ducts for areas (or units) indicated to have such sensors, except where a wall sensor is indicated on the plans provide a wall mount type. Install where units would be easily accessible for maintenance. Indicate locations on floor plans with submittals.

3.02 MONITORING DATA

- A. General: Monitoring information shall be provided at graphic user interface. Provide all necessary controls/devices to provide the data indicated. Monitoring data listed is not a

"points list" but is a list of items that shall be monitored and is in addition to data (or "points") required by the sequence of operation and other specification requirements. A complete "points list" shall be compiled by the Division 25 Contractor based on all system requirements and sequence.

B. Chiller:

1. Unit commanded on/off status.
2. Entering water temperature.
3. Leaving water temperature.
4. Alarm Indication each compressor circuit (connect to unit contacts).
5. Compressor on/off (digital signal via CT's at power supply to each compressor).
6. Water temperature setpoint.
7. Water temperature setpoint adjustment.
8. Water temperature at chiller: Indicate alarm if below 35 degrees F (adjustable) for freeze protection.

C. Cooling Water Loops:

1. Main return temperature.
2. Main supply temperature before mixing valve (heating loop).
3. Main supply temperature after mixing valve (heating loop).
4. Main supply setpoint.
5. Boiler (and chiller) main line supply temp.

D. Air Handling Units (all units with fans and ability to heat or cool environmental air):

1. Zone temperature.
2. Zone temperature setpoint.
3. Unit commanded mode (heating/cooling).
4. Supply air temperature off unit.
5. Mixed air temperature at unit.
6. Percent commanded heating or cooling.
7. Override status.
8. Outside air and return damper positions (% commanded open).

9. Fan on/off.
 10. Fan commanded position (on/off).
 11. Alarm/trouble conditions, shall include as a minimum: freezestat alarm; fan not "proven" on when should be on; heat failure alarm - SA temp not warmer than ma and unit is in heating; cooling failure alarm - SA not cooler than ma and unit is in cooling; "false" cooling or heating call - i.e. Unit calls for heating when OA temperature is above 70 deg F, unit calls for cooling and OA temperature is below 30deg F).
 12. Carbon dioxide levels.
- E. Circulating Pumps:
1. On/Off status (by differential pressure device or flow switch).
 2. Failure alarm (i.e. not "proven" on when commanded on).
 3. Variable frequency drive (VFD) commanded position (as applicable).

3.03 START-UP

- A. Calibration and Commissioning: As each part of the systems become operational, this Contractor shall calibrate all sensing and readout devices and shall test and observe the operation of each and every air moving and/or heating unit and shall adjust all controls so that the items function according to the intent of the specifications. The control contractor shall commission all controls prior to the work of Section 23 08 00 being done. This commissioning work shall include a point-to-point check of all devices, check of sequences, check of proper wiring, and documentation substantiating the work.
- B. Report/Statement: After making all necessary system testing and adjusting, the Contractor shall submit a report to the Engineer indicating all testing/adjustment work done and comment on how system is operating. Such report shall be signed by the individual directly responsible for supervision of the installation of the control system. When the Contractor feels that the system is complete and ready for review by the Engineer, Contractor shall submit a written statement (signed by same individuals as for report) stating that the system is in compliance with the project requirements and ready for review.
- C. Owner Instruction: See Section 23 05 00.
- D. Start-up Trend Logs: The Contractor shall submit to and review with the Engineer daily for a period of four weeks after substantial completion a hard copy log of the following:
1. Five Owner selected room temperature values at 15 minute intervals.
 2. Outside air temperature values at 15 minute intervals.
- E. Warranty Trend Logs: Two months after Owner acceptance of the work, the Contractor shall submit to and review with the Engineer a single tabulated 30 day hard copy printout of the systems historical data containing the following information:
1. Date.
 2. Hour by hour zone temperature, for five Owner selected rooms.

3. Hour by hour OA temperature.
- F. Documentation: Contractor shall provide a hard copy documentation of the software application program for each digital controller (TUC, NAC). Documentation provided shall include block software flow chart showing the interconnection between each of the control algorithms and sequences for systems utilizing program listings. A program listing shall be printed onto the same blueprint, along with the program flow chart, and description of the sequence of operation. A hard copy of this document shall be stored and maintained in each stand-alone digital controller panel. System acceptance shall not be completed until this documentation is provided and located in each panel.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Requirements of Section 23 05 00 apply to this Section.

1.02 WORK INCLUDED

- A. Control System Design.
- B. Control System Sequence of Operation.

1.03 SUBMITTALS

- A. General: Comply with Section 23 05 00.
- B. Sequences: Submit complete description of sequence of operation for all systems. Sequence submitted shall not be a direct copy of the sequence specified herein, but shall be written to reflect the actual control sequences provided and to more closely match the actual programming used.
- C. Programming: Submit copy of system programming logic.

1.04 GENERAL REQUIREMENTS

- A. Bidder Design: The control system is bidder designed subject to the requirements of the Contract Documents.
- B. Modifications: Software, graphics, and sequences shall be revised and updated as necessary to reflect Owner or Engineer desired changes. Contractor to include in bid no less than 16 hours of control technician's/programmer's time to accomplish the required system modifications.
- C. Sequence Terminology: Wherever the control sequences refer to an article, device or piece of equipment in the singular number, such reference shall mean to include as many of such articles, devices, or equipment as are shown on the plans, required for the sequence, or required to complete the installation. Wherever the control sequence refers to an operating stage in the singular number, such reference shall mean to include as many stages as are specified for the equipment and shall mean analog (i.e. proportional) type control where specified for the equipment (reference drawings and equipment specifications).
- D. All DDC Control: All controls and sequences shall be provided by the Division 25 DDC control system, unless specifically noted otherwise. Where interval timer, switch control, or a similar manual control is indicated, the control device shall provide an input to the DDC system with the DDC system providing an output for control. No line voltage controls or other controls which do not "pass through" the DDC control system are allowed, unless directly stated that is the method of control to be used. Exceptions to DDC Control: emergency shut-down and similar safety devices required (or noted) to be hard wired.

PART 2 - PRODUCTS

NOT USED

PART 3 - INSTALLATION

3.01 GENERAL

A. Complete System:

1. General: Provide complete control system design, all software, programming, wiring, and control devices as required to allow for automatic control of all mechanical equipment and other systems as indicated; with sequences of operation and features specified. Provide all control interconnections between indoor and outdoor units, all required control connections between equipment components, and to any other devices needed for proper operation. See also Section 25 50 00 for related requirements.
2. Various thermostats, motorized dampers, and other devices are not shown on the drawings but are required per the sequence of operation specified. Coordinate with Engineer for location of all such devices prior to installing. Indicate proposed locations on submittals.

B. Sequences:

1. Additional Sequences: See Section 25 50 00 for system requirements that relate to control sequences; see drawings for additional control sequences and requirements.
2. Control Action: Sequences which involve maintaining a setpoint in response to variable conditions shall use proportional-integral (PI) or proportional-integral-derivative (PID) control (unless noted otherwise). Sequences shall comply with the system performance requirements and other requirements of Section 25 50 00.
3. Missing Sequences: Where no sequence of operation is indicated submit a proposed sequence to the Engineer for review. Such sequences shall match the intended equipment use, code, and ASHRAE standards for the type of equipment and application. HVAC equipment shall have control of heating/cooling operation by area thermostats and control of unit components (i.e. fans dampers) to allow for distribution of heating/cooling and control of ventilation air; fans and similar on/off items shall have time schedule and thermostat control (unless the application clearly implies a different method).

C. Settings:

1. Adjustability: All settings, setpoints, and differentials shall be adjustable. All setpoints indicated are initial settings.
2. Confirm Settings: Confirm with Owner all setpoints, all time schedules, and all other adjustable programming parameters before substantial completion.
3. Thermostat Setpoints: Shall be adjustable at operator's workstation, with initial

settings as follows unless indicated otherwise:

Occupied Heating	70 degrees F
Unoccupied Heating	65 degrees F
Occupied Cooling	75 degrees F
Unoccupied Cooling	85 degrees F

D. Time Control:

1. Control system shall provide time schedules for occupied/unoccupied mode switching for all items having sequences with occupied/unoccupied modes, and for all items indicated as having time schedule control.
2. Provide independent time schedules for all mechanical equipment, except where equipment is indicated to be interlocked to other equipment.
3. Provide seasonal (i.e. time of year) control for all mechanical equipment.
4. Provide a single Holiday Schedule or Master Holiday schedule for logical equipment groups as directed by the Owner at submittal time and revised by the Owner during the Owner training. At the end of the warranty period readjust the grouping of equipment as directed by the Owner.
5. Provide independent optimum start schedules (i.e. warm-up cycles) for mechanical equipment indicated to have (or required to have) optimum start.

E. Hand-Off-Auto Control: Provide all control devices and connections to allow Hand-Off-Auto (HOA) control of all controlled items; where unit starters or VFD's provide HOA control, no additional controls are required, but this Section controls shall be arranged to allow for HOA controls.

F. Variable Speed Operation: On variable speed (including staged) equipment, start equipment low speed (or other appropriate speed as recommended by equipment manufacturer or system requirements) and control speed changes at a rate that is coordinated with other equipment to provide proper system operation without undesirable effects, nuisance trips and system alarms.

G. Alarms: Provide alarms for the following:

1. Status of item does not equal commanded status (where proof of status is monitored, e.g. supply fan not proven on when commanded on).
2. Equipment in alarm (where equipment alarm state is monitored).
3. System response is not consistent with commanded response (e.g. air handling unit SA temperature is not less than MA temperature and unit is commanded to cooling).
5. Safety device alarm (where device is monitored by or connected to the control system).
6. Space temperature in alarm range (10 deg F or more above cooling setpoint; 10 deg F or more below heating setpoint).

7. Sensor failure (out of range).

H. Fire/Smoke Shutdown:

1. Smoke Detector: Provide necessary conduit, wiring, and accessories to shutdown each unit upon activation of that unit's smoke detectors. Connections shall be hardwired; independent of any control system logic, so that failure of control system or loss of control system will in no way prevent the shutdown of each unit. In addition to shutting down the unit with the alarmed smoke detector, all equipment interlocked or served by that unit shall be off. Other units shall also shut-off as required to avoid building pressure differentials and similar undesirable effects.
2. Fire Alarm System: Shut-down all air handling equipment when the building fire alarm system goes into alarm. Contacts in the fire alarm system are available for this purpose. This shut-down may be accomplished by use of control logic and is not required to be hardwired but shall be of a fail-safe nature so as to provide the necessary shut-down in case of control failure and the control components shall be rated for such purposes (as required by the AHJ).

I. Automatic Restart:

1. General: Equipment shall automatically restart after being shut-off by a power outage, fire alarm, smoke detector, or similar alarm (or fault); upon clearing of the alarm (or fault). System shall revert to its normal operation for the conditions at the time of restarting.
2. Controlled Restart: Provide controlled re-start by building wing or building floor and in a manner to prevent pressure differentials, equipment issues, or other undesirable effects. Provide time delay on the re-start of equipment 2.5 KW and larger to minimize electrical surges.

- J. Interlocks: May be accomplished by software rather than field hard wired relays or other devices, except for: fire alarm shut-down of equipment 2000 cfm and greater, freezestat shutdown, chiller emergency shut-off switches, where required by manufacturers, where required by AHJ, and where noted to be hard-wired.

3.02 HVAC UNITS – SEQUENCE OF OPERATION

A. General:

1. Control unit's cooling, heating, and system dampers (economizer), in proper sequence to provide a supply air temperature that will satisfy space conditions.
2. Heating and cooling shall be properly sequenced so that there is no overlap between the use of heating and cooling.
3. Controls shall evaluate the space deviation from setpoint and rate of change of this deviation to determine heating/cooling and economizer operation to satisfy setpoint without excess variation in space temperatures.

B. Occupied Mode:

1. Fan: Fan shall run continuously.

2. Shall be activated by central time schedule or if any thermostat's override mode is activated.
 3. Heating: Gas heat shall provide modulating heat or staged heat to match unit capabilities.
 4. Cooling: Units with economizers shall use outside air economizer as the first stage of cooling. Economizer shall be dry bulb or enthalpy type, using OA temperature sensor, Mixed Air (MA) temperature sensor and supply air (SA) temperature control scheme. Economizer shall be enabled only when OA temperature (or enthalpy) is less than the units Return Air (RA) temperature (or enthalpy). The OA/RA dampers shall be modulated as required to satisfy the SA temperature control scheme and shall be limited by a MA sensor low limit setpoint (initial setpoint 54 degrees F). Heat pump shall operate in the cooling mode as the final stage of cooling.
 5. OA Dampers: OA dampers shall be under CO2 control when unit is in heating, and under economizer and CO2 control when unit is in cooling; whichever is calling for the most open OA damper position (i.e. the economizer or the CO2 control) shall control the OA damper. CO2 controls shall modulate the OA damper to maintain the space CO2 level setpoint; initial setpoint shall be 600 ppm. OA damper shall not close below a position that provides 50% of the minimum OA flow indicated on the plans (unless noted otherwise). When the unit is in the heating mode the OA damper shall never open greater than a position that provides the minimum OA flow indicated on the plans. Upon entering the occupied mode, the OA damper shall initially open to a position that provides 50% of the minimum OA flow indicated on the plans. Coordinate with balancer for OA damper positions that meet the flow settings.
 6. Relief Dampers: Motorized relief dampers (where applicable) shall operate in unison with the OA dampers to progressively open as the OA dampers open; provide with an offset control so that the relief dampers do not begin opening until the OA dampers are at least 15% open.
 7. Powered Relief Fan: Shall be controlled by OA damper position space pressurization and be on when the OA damper space pressurization is 75% or more open greater than 0.08-inch w.c.
- C. Unoccupied Mode: Unit fan and heating/cooling shall cycle on and off as required to maintain unoccupied setpoints. OA dampers shall be fully closed unless economizer cooling is required. Powered relief fans shall be off (i.e. when there is an equal variation in offset between heating and cooling, unit shall operate in cooling).
- D. Warm-up Mode: Unit shall run as in the unoccupied mode (OA fully closed) until the space temperature has warmed up to the occupied mode heating setpoint, then unit shall operate as specified for the occupied mode.
- E. Mode Control: Units' mode of operation shall be determined by time schedule and time schedule override; warm-up mode shall be initiated by optimum start controls.

3.03 PUMPS

- A. General: Pumps shall be re-connected to existing controls and utilize existing sequences that served replaced equipment. Where no such sequences exist, the following may be

used:

- B. Chiller Pumps: Pump shall be interlocked with chiller and shall be on when chiller is enabled on. Provide delay-on and delay-off control so that chiller is commanded on after pump is commanded on, and pump continues to run after chiller is commanded off. Delay shall be 1 minute.
- C. Cooling Secondary Pump: Pump shall operate whenever chiller is enabled. Provide VFD and control pump to maintain system differential pressure constant. Measure differential pressure at approximate 2/3 point of system.

3.04 CHILLER

- A. General: Chillers shall be re-connected to existing controls and utilize existing sequences that served replaced equipment. Where no such sequences exist, the following may be used:
- B. Water Temperature: Chiller staging and water temperature control shall be by integral controls furnished with chiller (see Section 23 64 00).
- C. On/Off Sequence: Chiller shall be enabled to operate by an outdoor air thermostat and time schedule. When outdoor air temperature is 3 degrees above setpoint and time schedule is in the enabled mode, the chiller and pump shall be enabled. When the outdoor air temperature is below setpoint or the time schedule is in the disabled mode, the chiller and pump shall be off. Initial setpoint shall be 60 degrees F and shall be adjustable at the GUI. Initial time schedule (adjustable) shall enable the chiller from April 15 to June 30 and from August 15 to September 30, and during occupied hours within those periods.
- D. OA Reset: Provide linear OA reset of CHS temperature from chiller between the following limits; coordinate with Section 23 64 00.

OA Temperature
75°
85°

CHS Temperature
46°
42°

END OF SECTION

DIVISION 26
ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

- A. General requirements specifically applicable to Division 26.

1.03 SCOPE OF ELECTRICAL WORK

- A. Provide electrical systems and Work described, identified, specified, referenced, and shown in the Project Documents that are covered under Divisions 26 of the Construction Specifications Institute (CSI) and/or as otherwise regulated by national, state, and local electrical codes. Electrical Work includes providing all equipment, materials, devices, appurtenances, and accessories necessary to provide complete and operating systems according to the intent of Project Documents.
- B. Electrical work is not limited to Division 26 specifications and what is shown on the electrical drawings. The Contractor is responsible to review all Project Documents for additional Electrical Work and requirements and to include this work as part of their scope under the Contract.

1.04 REGULATORY REQUIREMENTS

- A. Comply with requirements of the following codes as adopted and supplemented by authority having jurisdiction:
 - ANSI/NFPA 70 - National Electric Code (NEC)
 - NFPA 101 - Life Safety Code
 - International Building Code (IBC)
 - International Mechanical Code (IMC)
 - WAC 296-46B - Washington State Electrical Safety Standards, Administration, and Installation
 - Washington State Energy Code (WSEC)
- B. Comply with additional codes and regulations referenced in other sections.
- C. Comply with additional codes and regulations required by authority having jurisdiction.
- D. Obtain and pay for permits, and inspections from authorities having jurisdiction over work included under applicable Division Sections.
- E. Include all testing, shop drawings, and documentation required by the inspection authorities for permitting and final approval.

1.05 SUBMITTALS

- A. Comply with requirements of Division 01. Unless otherwise specified, furnish product data and shop drawings to Architect/Engineer as follows:
 - 1. Product information sheets shall be neat, readable, 8.5 x 11 inch, submitted in

- PDF format. Generic product sheets with multiple products or product descriptions shall clearly highlight or otherwise indicate which product is being furnished. Product sheets shall be reasonably limited to not include entire catalog sections.
2. Furnish product submittals with a cover sheet and table of contents. Furnish a separate submittal and number for each section of the specifications. Cover sheet shall indicate name of the Project, Owner, Architect, Engineer, Contractor, and Date of Submittal. Product table of contents shall list each item submitted. Bookmark each submittal to facilitate browsing according to the type of products.
 3. Furnish systems design shop drawings in PDF format. Title block shall include Project, Owner, Contractor, and Date of Submittal.
 4. Furnish product data and shop drawings specifically indicating any conflict or deviation from requirements of contract documents.
 5. Edited Content: Submittals shall indicate the equipment and options that are to be provided. Copies of an unedited catalog will be Rejected. Pages/items that are not applicable shall be deleted prior to submittal to the Engineer.
- B. Confirm dimensions, ratings, and specifications of electrical materials, devices, fixtures, and equipment conform to project requirements prior to furnishing submittals. Coordinate electrical requirements with utilization equipment submitted under other sections and verify that voltage, phase, and rating are compatible with work shown in the electrical project documents.
- C. Do not order materials or commence Work until applicable submittal has been reviewed and the Architect/Engineer has accepted.
- D. Re-Submittals: If submittals are marked 'Rejected' or 'Revise and Resubmit', the Contractor shall revise the submittal to satisfy the comments or conform to project requirements, and submit to the Engineer for review. Only those items that were rejected or required a resubmittal will be reviewed by the Engineer; All other items will not be reviewed. All re-submittals shall be at least one of the following:
1. Provide a 'Re-Submittal Summary Sheet' which indicates how each comment was addressed (it is acceptable to add the responses to a copy of the original submittal review comments).
 2. Cloud (or otherwise clearly identify) the revised portions to indicate what is different from the original submittal.

1.06 SUBSTITUTIONS

- A. Comply with requirements of Division 01. Products specified by naming one or more manufacturers establishes a basis for quality, styling, capacity, and function. Unless otherwise specified, written requests for substitution must be received at least 14 days prior to Bid Opening by Architect/Engineer who will determine acceptability of proposed substitution. Written acceptance must be obtained from Architect/Engineer prior to Bid Opening.
- B. Substitution requests may be submitted for any manufacturer or named product unless specified as "no substitute".

- C. Substitution approval does not relieve the Contractor of complying with the work requirements or the concept and intent of the project documents. Pay for any and all additional project costs that may be caused by Contractor requested substitutions, regardless of whether or not additional costs are overlooked, missed, or unforeseen, and regardless of when substitutions may be approved.

1.07 RECORD DOCUMENTS

- A. Comply with requirements of Division 01. Maintain at project site one set of clean, dry, and legible red-lined record drawings for submittal at Contract Close-out. Record information concurrently with construction progress.
- B. Indicate electrical changes in the contract documents. Include change orders, revised branch circuit and feeder wiring layouts, revised circuit identification, pull & junction boxes added during construction, and actual dimensioned location and routing of each underground conduit on record drawings.

1.08 LABELING

- A. Where labeling that includes room names and numbers is required for any system to identify devices or for programming purposes, use final room names and numbers determined during construction. Verify room names and numbers with Architect prior to manufacturing labels or programming software.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Comply with requirements of Division 01. Unless otherwise specified, furnish one labeled CD in PDF format and two duplicate hard copy printed sets of Operation and Maintenance Manuals prior to completion of contract. Submit hard copy manuals in labeled and indexed 3-ring binder(s).
- B. Include the following information as applicable:
 - 1. Names, addresses, and telephone numbers of the contractor, the installing sub-contractor, and the local representative for each system or equipment.
 - 2. All approved product data and shop drawings.
 - 3. Identify all manufacturer warranties which exceed one year.
 - 4. Model number and serial number of each piece of equipment provided.
 - 5. Data from test results performed under the Contract.
- C. Operation and maintenance data shall include complete parts lists, installation and maintenance instructions, safety precautions, operation sequence describing start-up, operation, and shut-down, internal and interconnecting wiring and control diagrams with data to explain detailed operation and control, and testing methods for each system and item of equipment.
- D. Furnish a draft copy of Operations and Maintenance Manual for Architect/Engineer review and incorporate comments prior to final submittal. Allow 14 days for Architect/Engineer review.

1.10 CONFLICTS

- A. Notify the Architect/Engineer of any conflicts or discrepancies before proceeding with any work or the purchasing of any materials related to the conflict or discrepancy until requesting and obtaining written instructions from the Architect/Engineer on how to proceed. Where conflicts occur, the most expensive and stringent requirement as judged by the Architect/Engineer shall prevail. Any work done after discovery of such discrepancies or conflicts and prior to obtaining the Architect/Engineer's instructions on how to proceed shall be done at the Contractor's expense.

1.11 WARRANTY

- A. In addition to requirements covered under General Conditions or Division 01, include manufacturer product warranties that exceed one year. Assemble or list warranties that exceed one year in Operation and Maintenance Manuals indicating start date. Certificates of extended warranty shall identify the Owner as the beneficiary.
- B. If the Electrical Contractor does not have offices located within 150 miles of the project, provide a service/warranty work agreement with a local electrical subcontractor approved by the Owner. The service/warranty work agreement shall extend for the contract warranty period, and a copy shall be included in the Operation and Maintenance Manuals.

1.12 INTENT OF PROJECT DOCUMENTS

- A. Drawings and specifications are complementary and what is called for in either is binding as if called for in both.
- B. The drawings are diagrammatic and show the general arrangement of the construction and do not attempt to show all features of work, exact construction details, or actual routing of conduit and cable. Provide all necessary supports, off-sets, bends, risers, fittings, boxes, wiring, and accessories which are required for a complete and operating installation. Determine locations for required electrical outlets and connections prior to rough-in base on equipment product and installation submittal data and/or review of equipment on site.
- C. The level of design presented in the documents represents the extent of the design being furnished to the Contractor; any additional design needed to perform the Work shall be provided by the Contractor. All design by the Contractor shall be performed by individuals skilled and experienced in such work, and where required by local code (or elsewhere in the documents) shall be performed by engineers licensed in the State where the project is located. Include in bid the costs of all such project design; including engineering, drafting, coordination, and all related activities and work. Contractor provided design services shall be included for but not limited to bidder design specifications, temporary electrical systems, layout routing to install the Work and share project space with other building systems, hanger and support systems, seismic bracing, preparation of shop drawings, locating and identifying requirements for equipment and fixture terminations, and methods/means of accomplishing the work.

1.13 COORDINATION

- A. Examine architectural, civil, structural, and mechanical drawings and specifications and consult with other trades, as required to coordinate use of Project space and sequence of installation.

- B. Arrange wiring and equipment to avoid interference with other work and to maximize accessibility for maintenance and repairs.
- C. Coordinate with suppliers and installers to obtain product electrical data, shop drawings, and installation requirements for systems, equipment, and products furnished by Owner and/or other trades as required perform electrical work.
- D. Contractor is responsible ensure that equipment, fixtures, and devices being furnished and installed shall fit the space available, taking into account connections, service access, and clearances required by product manufacturer and/or Code. Contractor shall make the necessary field measurements to ascertain the space requirements for proper installation, and shall furnish and/or install equipment so that final installation meets the intent of the Project Documents. If approval is received by Addendum or Change Order to use other than the originally specified items, Contractor shall be responsible for specified capacities and for ensuring that items to be furnished will fit the space available.
- E. Contractor is responsible to review all the Project Documents and approved shop drawings provide under other divisions to identify and resolve conflicts between electrical systems and building construction, equipment, cabinets, counters, trim, and special finishes, prior to rough-in.
- F. Facilitate coordination between low voltage system sub-contractors during construction. Include time for a minimum of one meeting with all sub-contractors prior to building rough-in to review requirements for each system per Section 26 05 30. Include a second meeting with all sub-contractors to review requirements for all systems utilizing IP structured cabling prior to cover.

1.14 REQUIREMENTS FOR EQUIPMENT FURNISHED UNDER OTHER SECTIONS OR BY OWNER

- A. Provide power wiring, disconnect switches, electrical connection of equipment, installation of furnished electrical controllers, parts, and accessories, and field wiring for systems, equipment, and products furnished under other divisions or by Owner. Install controllers, operator stations, and control devices such as limit and temperature switches furnished with equipment.
- B. Review equipment submittals prior to electrical rough-in and installation. Verify location, rating, size, type of connections, and required space requirements. Coordinate field wiring requirements and details with supplier and installer. Notify Architect/Engineer of conflicts between requirements for actual equipment being furnished and equipment indicated in contract documents prior to commencing Work.
- C. Provide motor controllers and operator stations unless otherwise indicated on the project drawings.
- D. Make final connections to equipment. Provide cord and plug where required for plug-in connection.
- E. Integrated automation systems covered under Division 25 are not included as part of electrical work.

1.15 DEFINITIONS

- A. Electrical terms used in these specifications are as defined in NEC Art. 100 unless

otherwise noted.

- B. Abbreviations: Where not defined elsewhere in the Contract Documents, shall be as defined in RS Means Illustrated Construction Dictionary.
- C. Accessible Ceiling: Signifies access that requires the removal of an access panel or similar removable obstruction.
- D. The term "Architect," "Architect/Engineer" or "Engineer," means Hultz|BHU Engineers, 1111 Fawcett Avenue, Suite 100, Tacoma, WA, 98402.
- E. As Required: As necessary to form a safe, neat, and complete working installation (or product), fulfilling all the requirements of the specifications and drawings and in compliance with all codes.
- F. Concealed: Hidden from view as in walls, trenches, chases, furred spaces, crawl spaces, unfinished attics, and above suspended ceilings.
- G. Conduit: Includes conduit and tubing raceways.
- H. Coordinate: Accomplish the work with all others that are involved in the work by directly discussing the work with them, arranging and participating in special meetings with them to discuss and plan the work being done by each, obtaining and completing any necessary forms and documentation required for the work to proceed, reaching agreement on how parts of the work performed by each trade will be installed relative to each other both in physical location and in time sequence, exchanging all necessary information so as to allow the work to be accomplished with a united effort in accordance with the project requirements.
- I. Equipment Connection: Make branch circuit connection, mount and connect control devices as required. Provide disconnect and overcurrent protection when required by NEC and IMC, if not otherwise indicated or furnished with equipment.
- J. Exposed: Exposed to view in any room, hallway, passageway or outdoors.
- K. Finished Areas or Spaces: Areas and/or spaces receiving a finish coat of paint on one or more wall surface.
- L. Furnish: Obtain and/or prepare and deliver to the project.
- M. Indicated: Shown, scheduled, noted, or otherwise called out on the drawings.
- N. Install: Enter permanently into the project complete and ready for service.
- O. Open Cable or Wiring: Conductors above grade not installed in conduit or raceway.
- P. Panel: Distribution panelboard, lighting and appliance panelboard, load center, and/or low voltage cabinet.
- Q. Provide: Furnish and install complete and ready for service.
- R. Wiring: The assembly of conductors, raceways, outlets, junction boxes, conduit bodies, fittings, and associated accessories, or an approved cable assembly.

- S. Verify: Obtain, by a means independent of the project Architect/Engineer and Owner, the information noted and the information needed to properly perform the work.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT

- A. General: Furnish only products that are new and free from defects with a manufacture date that is less than six months from date of installation. Where product and applicable software updates or upgrades are available from the manufacturer, furnish the latest version unless otherwise specified. Furnishing discontinued products and/or products of manufacturers who are no longer in business is not permitted.
- B. Listing and Labeling: Furnish and install only products that are listed and labeled by one or more of the following testing laboratories as approved by the Authority Having Jurisdiction:
- | | |
|----------------------------------|-------|
| Underwriter's Laboratories, Inc. | (UL) |
| ETL Testing Laboratories, Inc. | (ETL) |
| Factory Mutual | (FM) |
- C. Each specified product and system to be furnished shall be from a single approved manufacturer. Providing multiple product brands or manufacturers for each type or category, or for multiple units of the same specified product and/or system, is not permitted.
- D. Products shall be delivered, handled, and stored per manufacturer recommendations. Protect fixtures, materials, and equipment from rain, water, dust, dirt, snow, and damage. Do not install products that have marred, scratched, deformed, or otherwise damaged. Do not install products that have been wet or exposed to the weather prior to assembly and/or installation.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. Electrical work shall conform to requirements of ANSI/NECA 1-2015, Standard Practice of Good Workmanship in Electrical Construction.

3.02 INSTALLATION

- A. Provide all electrical work as specified and shown in the Project Documents. Provide all labor, equipment, material, accessories, and testing for electrical systems complete and operating. Include all scaffolding, rigging, hoisting, and services necessary for delivery and installation of materials and equipment.
- B. Include all required software applications, licensing and associated system programming for electronic products. Provide all software to owner for onsite programming and interfacing.
- C. Provide as part of the Electrical Work all hangers, brackets, supports, framing, backing, accessories, incidentals, not specifically identified the project documents, but required to

complete the system(s) in a safe and satisfactory working condition.

- D. Quantity of materials and layout of the Work shall be provided based on field measurement of the actual project conditions and shall not be based on plan dimensions.
- E. Provide all testing and documentation of electrical systems as required to demonstrate compliance with the Project Documents.
- F. Provide testing, documentation, and filing required to comply with commissioning requirements of Section C408 of the Energy Code. Include documentation in Operation and Maintenance Manuals.

3.03 CUTTING AND PATCHING

- A. Provide cutting and patching to complete electrical work and to provide openings in elements of Work for electrical penetrations. Comply with requirements of Division 01.
- B. Locate and execute cuts so as not to damage other work or weaken structural components. Core drill or saw cut rigid materials.
- C. Patch to restore to original condition. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

- A. Demolition of systems applicable to Division 26.
- B. Requirements for remodeling applicable to Division 26.

1.03 EXISTING CONDITIONS

- A. The drawings show portions of existing electrical systems which are to remain, be removed, or be modified under the Contract. Concealed features of existing systems are based on field observation and existing record drawings. No guarantee is made as to their correctness.
- B. Contractors shall visit the project site prior to bidding and become familiar with the existing conditions and all other factors which may affect the execution of the work. Include all costs related to existing site conditions in the initial bid proposal. Many systems may not comply with NETA or other maintenance standards and may require special precautions and procedures.
- C. Failure to visit the project site prior to bid does not relieve the Contractor of the responsibility to provide all required work and a complete installation within the intent of the Contract Documents.

1.04 EXISTING UNDERGROUND UTILITIES

- A. Existing utilities in areas of new construction must be identified and located by the Contractor prior to commencing Work. Location of underground utilities shown on plans, are diagrammatic and shall not be considered as a complete representation of all utilities that may exist on site.
- B. Coordinate with Owner to identify and locate existing underground utilities including landscape irrigation in areas of Work.
- C. Prior to excavation, contact and coordinate with local Utilities Underground Location Center to identify and locate existing underground public utility services in areas of Work, including power, water, sewer, telephone, gas, and cable TV.
- D. Prior to excavation, obtain services of a utility locator service to scan areas of Work and to locate and mark where known and unknown private underground utilities or other interfering obstructions exist.
- E. Hand excavate to expose located interfering underground utilities and interfering obstructions before trenching. Provide adequate means of support and protection of exposed utilities.

- F. Existing active utilities damaged or interrupted by the Contractor during construction shall be replaced at the Contractor's expense. Repairs to power and signal systems using junction boxes or splices will not be accepted.

1.05 POWER AND SIGNAL OUTAGES

- A. The facility will continue normal operations during the construction work. The Contractor shall schedule power outages with the Architect/Engineer. Include coordination, identification of affected areas, work schedule, and re-energizing of electrical systems with minimal disruption to facility operations.
- B. Unscheduled power or signal outages to Owner occupied areas and systems essential to facility operation or life safety shall not be permitted at any time. In the event that the Contractor's work causes or contributes to a power outage or other system fault, the Contractor is responsible for immediately correcting the problem.
- C. Schedule power and signal outages for evenings, weekends, or holidays unless otherwise approved; include costs for overtime and work outside regular hours.

1.06 FIRE ALARM SYSTEM

- A. Maintain and operate the existing fire alarm system during construction. Comply with alarm, incident response, and fire watch requirements of the Authorities Having Jurisdiction for all areas served by the system. Plan and provide fire watch and/or temporary wiring where new construction interrupts required system operation.
- B. Provide dust protection for installed smoke detectors located within the work area. Clean detectors after work is completed and dust protection is removed.
- C. Coordinate all planned shutdowns and tests of the fire alarm system with the Fire Department and Alarm Reporting Center. Notify the Alarm Reporting Center of false alarms that occur during construction as required to mitigate Fire Department response.
- D. Provide investigation, correction, and required repairs to the alarm system for false alarms and system trouble that occur during the project and for system failures caused by the Work. Fines and penalties for excessive false alarms that occur during the Project shall be the responsibility of the Contractor.
- E. The Owner shall provide reimbursement for expenses associated with false alarms, system trouble, and system failure if the contractor can satisfactorily demonstrate that the incidents are not related to the Project.

1.07 INTRUSION ALARM SYSTEM

- A. Maintain and operate the existing intrusion alarm system during construction. Comply with alarm and incident response requirements of the monitoring agency and Owner for all areas served by the system. Provide temporary wiring where new construction interrupts required system operation.
- B. Provide dust protection for installed motion sensors located within the work area. Clean detectors after work is completed and dust protection is removed.

- C. Coordinate all planned shutdowns and tests of the alarm system with Alarm Reporting Center. Notify the Alarm Reporting Center of false alarms that occur during construction as required to mitigate police response.
- D. Provide investigation, correction, and required repairs to the alarm system for false alarms and system trouble that occur during the project and for system failures caused by the Work. Fines and penalties for excessive false alarms that occur during the Project shall be the responsibility of the Contractor.
- E. The Owner shall provide reimbursement for expenses associated with false alarms, system trouble, and system failure if the contractor can satisfactorily demonstrate that the incidents are not related to the Project.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. New and Replacement Materials and Equipment: As specified in applicable sections, except product manufacture shall match existing for minor construction and for accessories to equipment that remains.
- B. Materials and Equipment for Patching: Match existing products.
- C. In finished spaces provide surface metal raceway systems as specified in other sections where existing construction does not permit concealed installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Field verify wiring and cabling for existing power and signal systems back to source of supply as required to perform Work.
- B. Cut and Patch conduit penetrations and required holes to access work at walls.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing systems to accommodate new construction. For selective demolition, refer to architectural and mechanical plans and include electrical demolition to support removal and replacement work not otherwise indicated in electrical drawings.
- B. Electrical demolition includes the disconnecting, removal, and disposal of fixtures, devices and equipment where indicated, along with associated wiring.
- C. The following shall be considered as abandoned unless otherwise indicated:
 - 1. Wiring to fixtures, devices, and equipment being removed or disconnected.
 - 2. Conduit containing conductors or cable that have been disconnected from a source of supply or left empty by the removal of conductors.

3. Open conductors or cable that have been disconnected from a source of supply.
 4. Fixtures, devices, equipment, and outlets located in walls, ceilings, and floors indicated to be removed.
 5. Fixtures, devices, and equipment identified as being replaced.
- D. Remove abandoned wire and cable for power and signal systems to source of supply.
 - E. Remove abandoned conduit, cable, and outlets where exposed and within accessible ceiling, attic, crawl, plenum, and opened wall spaces. Cut conduit flush with walls and floors; patch surfaces in finished spaces. Outdoors remove abandoned conduit and cable down to 24 inches below grade and restore site to its original grade and finish.
 - F. Disconnect abandoned outlets and remove devices. Provide blank covers for abandoned outlet boxes in floors, walls, and hard ceilings to remain.
 - G. Disconnect and remove abandoned switchboards, panelboards, distribution equipment, and electrical devices.
 - H. Disconnect power to utilization equipment being removed or abandoned in place.
 - I. Disconnect and remove abandoned light fixtures, including brackets, stems, hangers, pole base and other accessories.
 - J. Repair adjacent construction and finishes damaged during demolition and extension work.
 - K. Cut-in flush outlet boxes and fish conduit in existing construction of remodeled areas where conditions permit. Flexible conduit is approved where fishing of conduit is required. Where existing construction does not permit flush installation, use surface metal raceway.
 - L. Extend existing outlet boxes as required to accommodate new surface treatments or to extend wiring with surface raceway.
 - M. Maintain access to existing electrical systems to remain active. Modify installation or provide access panels as appropriate.
 - N. Replace, modify or extend existing outlet boxes to meet volume requirements. Cut surfaces as required to replace (or modify) existing outlet boxes and to install supports for new boxes and fixtures and patch to match adjacent surface.
 - O. Provide new supports for existing conduit and open cable accessed during construction and which is to remain or be reused, as required to comply with current Code. Comply with requirements of applicable signal system specifications for support of signal cables.

3.03 DISPOSITION OF MATERIALS

- A. Prior to start of demolition, coordinate with Owner to identify materials and equipment for salvage. Disconnect and remove items to be salvaged and deliver to an area on site designated by the Owner. Disconnect, remove, and handle salvage material and equipment in a manner so as not to damage or otherwise render unusable.

- B. Materials and equipment removed and not reused or salvaged to the Owner shall become the property of the Contractor unless otherwise indicated. Remove such material and equipment from the Owner's property and dispose legally off site.

3.04 NAMEPLATES AND CIRCUIT DIRECTORIES

- A. Provide nameplates for existing distribution equipment to indicate new and revised equipment, circuit, and load designations.
- B. Update panelboard and load center circuit directories to indicate changes and additions to each circuit. Updated and existing circuits shall be typewritten on new removable circuit index cards.
- C. Nameplates and circuit directories shall comply with requirements of Section 26 20 00.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Section 26 01 00 - Electrical General Requirements.
- B. Section 26 05 00 - Basic Materials and Methods.

1.02 SECTION INCLUDES

- A. Conduit and Fittings.
- B. Building Wire and Cable.
- C. Wiring Connections and Terminations.
- D. Boxes.
- E. Supporting Devices.
- F. Requirements for Fire Rated Construction.

1.03 SUBMITTALS

- A. Submit product data for conduit fittings, wire and cable, watertight connectors, and wiring devices.

1.04 OPERATION AND MAINTENANCE DATA

- A. Include data for wiring devices, floor boxes, smoke detectors, and cable tray in Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.01 CONDUIT

- A. Rigid Steel Conduit (RGS): ANSI C80.1; hot dipped galvanized.
- B. Intermediate Metal Conduit (IMC): Hot dipped galvanized.
- C. Electric Metallic Tubing (EMT): ANSI C80.3; galvanized tubing.
- D. Flexible Metal Conduit: Galvanized steel. Heavy wall except reduced wall may be used where concealed in building construction.
- E. Liquid Tight Flexible Metal Conduit: Galvanized steel, PVC jacket.
- F. Non-Metallic Conduit: NEMA TC 2; EPC-40-PVC and EPC-80-PVC.

2.02 FITTINGS

- A. RGS and IMC Conduit: ANSI/NEMA FB 1; threaded type. Provide bushings, hubs and connectors with insulated throat, for conduit terminations.

- B. EMT Conduit: ANSI/NEMA FB 1; steel, compression type. Crimp-on, drive-on, indenter, and set screw type prohibited. Provide connectors with insulated throat for conduit larger than 3/4-inch diameter. Provide raintight fittings for conduit installed outdoors.
- C. Flexible Conduit: ANSI/NEMA FB 1; steel, single screw squeeze type.
- D. Liquid Tight Flexible Conduit: ANSI C33.84, steel. Provide PVC coated fitting where installed outdoors.
- E. PVC Conduit: NEMA TC 3; solvent welded type, same manufacture as conduit. Provide bushings, hubs and connectors with insulated throat, for conduit terminations.
- F. Water and Vapor Conduit Sealants: Hydra-Seal S-50 conduit sealing putty or approved; Tyco/Rachem/TE blank duct plug or approved; Polywater FST conduit sealing foam system or approved.

2.03 WIRE AND CABLE

- A. Copper Building Wire, Interior: Type THWN-2, 600 volt insulation; conductors 8 AWG and larger shall be stranded. Type XHHW-2 may be substituted for conductor sizes 4 AWG and larger.
- B. Copper Building Wire, Outdoors: Type RHW/USE-2, 600 volt insulation; conductor 8 AWG and larger shall be stranded.
- C. Fire Rated Building Wire: Type RHH or RHW-2, UL2196, 600 volt insulation, copper conductor, UL classified 2-hour rated cable when installed in approved steel conduit system. Type RHH may be used only in dry locations.

2.04 WIRE CONNECTORS

- A. Connectors for Wire Size 10 AWG and Smaller: Insulated steel spring twist-on pressure connector with plastic cap. Outdoors use watertight type with prefilled sealant gel.
- B. Connectors for Wire Size 8 AWG and Larger: Solderless mechanical or compression type with pre-formed or shrink sleeve insulated cover. Outdoors make watertight using shrink sleeve or pigtail cap and sealing mastic.
- C. Outdoor Taps Below Grade for Wire Size #6 AWG and Larger: IlSCO PED series underground multi-tap, wire range and number of ports as required.
- D. Gutter/Wireway Taps for Wire Size #6 AWG and Larger: IlSCO type PDB series AL/CU lug type distribution block, number of poles and quantity/size of primary/secondary lug ports as required for the application.

2.05 BOXES

- A. Junction and Pull Boxes: Outlet box with blank cover except boxes larger than 4 inch square shall be screw cover type, galvanized steel with grey enamel finish, NEMA 1 indoors and NEMA 3R outdoors, unless otherwise indicated.
- B. Fire Rated Construction: Recessed outlet boxes and rough-in cans that are installed in 2 hour rated area separation walls shall be UL listed with 1-1/2 hour rating label.

- C. Color Coding of Device and Junction Boxes for Special Systems: Field painted or otherwise manufactured in the specified color, both inside and outside of box and cover. Provide color identification for the following electrical systems: Fire Alarm System - RED, Emergency Systems (NEC 700) - ORANGE.

2.06 SUPPORTING DEVICES

- A. Metal Conduit Clamps and Straps: Steel, screw type; zinc or cadmium plated minimum indoors, hot dipped galvanized minimum outdoors.
- B. Support Channel: Slotted 12-gauge steel channel with fittings, fasteners, brackets, clamps, floor plates, and accessories required; Pre-galvanized zinc coated (G90) indoors, ASTM 123 hot dipped galvanized outdoors.
- C. Fasteners: Expansion anchors in concrete and solid masonry; toggle bolts in hollow masonry, plaster, or gypsum board wall construction; sheet metal screws in metal construction; wood screws in wood construction; set screw type beam clamps on steel columns and beams; U.L. listed clips for metal studs. Metal parts and accessories to be zinc or cadmium plated minimum indoors and hot dipped galvanized minimum outdoors.
- D. Support Wires: Support wires above accessible ceiling grids, steel #12 AWG minimum.
- E. Roof Supports: Do not install conduit exposed on roofs.

2.07 ACCESSORIES

- A. Pulling Wire:
 - 1. Interior; continuous fiber pulling line, 190# tensile strength.
 - 2. Below grade; Polyester measuring pulling tape 5/8 inch wide, 1800# tensile strength. Muletape.

2.08 FIRE RATED CONSTRUCTION

- A. Products for Fire Stopping to Seal Around Enclosures and Annular Space between Conduit and Building Construction at Conduit Penetrations: ANSI/UL 1479; Comply with requirements of Division 07.
- B. Conduit Sleeves for Open Cable: ANSI/UL 1479; Fire stop conduit sleeve kit, with mounting escutcheons, gaskets, end bushings, warning labels, and non-hardening fire stop putty. SpecSeal READY SLEEVE, FS100 (1 inch diameter sleeve) and FS200 (2 inch diameter sleeve), or approved.
- C. Pathway Sleeves for Open Cable, Greater than 2 Inch Diameter: ANSI/UL1497; Fire stop rectangular sleeve kit, 3-inch wide by 3-inch high by 10.5-inch length, expandable in 6-inch increments, self-contained integral fire sealing system that automatically adjusts to the installed cable loading. Provide radius control modules (each end of pathway), single or multiple gang wall kits, and expansion modules as required. Specified Technologies, Inc., EZ-Path System Series 33 or approved.

PART 3 - EXECUTION

3.01 WIRING METHODS

A. General:

1. Fixed wiring shall be conductors installed in conduit.
2. Conceal all wiring within construction unless otherwise noted on drawings or specifically authorized by the Architect/Engineer.
3. Where contractor wiring methods require the application of conductor ampacity adjustment or correction factors under NEC 310.15, the contractor shall submit calculations that show Code compliance, except the adjusted ampacity of the conductors installed shall not be less than the circuit overcurrent device rating shown or specified.
4. Conduit sizes shall not be reduced to smaller size than shown or otherwise noted on plans.
5. Feeders shown or otherwise noted on plans shall not be combined to share a common conduit homerun. Branch circuit homeruns shown or otherwise noted on plans shall not be combined to share a common conduit with other circuits.
6. Device Plates: It is the electrical contractor's responsibility to ensure that all line voltage and low voltage system faceplates and visible trim pieces are the same color. Exception: Where stainless steel device plates are used for line voltage systems, low voltage systems may use non-metallic plates of the same color.

B. Conduit Requirements:

1. Rigid Steel Conduit (RGS): May be used in all areas. Required at penetrations thru fire rated construction rated greater than 1 hour.
2. Intermediate Metal Conduit (IMC): May be used in all areas except where RGS is required or indicated.
3. Electrical Metallic Tubing (EMT): May be used in dry and damp locations where not subject to damage. May not be used in concrete, where in contact with earth, or where RGS is required or indicated. May not be used for service entrance conductors inside a building. Maximum trade size 2 inches.
4. Flexible Conduit: Required for final equipment connections (maximum length 36 inches). Use liquid tight in damp or wet locations.
5. Rigid Non-Metallic Conduit (PVC): May be used underground. May be used within buildings where encased in not less than 2 inches of concrete. Terminate inside building using RGS or IMC elbow and riser to first coupling above slab on grade.

C. Wire and Cable Requirements:

1. Use copper conductors.

3.02 SUPPORT - GENERAL

- A. Support wiring, conduit, raceways, boxes, equipment, and fixtures from building structural members. Provide additional framing, channel, or listed support attachments as required to span or support between structural members and to avoid interference from pipes, ducts, and other equipment.
- B. Do not install support anchors to penetrate thru roof deck.
- C. Do not violate the integrity or exceed the capacity of the building structure used for support. Provide/fabricate additional support elements to transmit loads to the floor or other parts of the building structure that can carry the load as approved by the Architect/Engineer.

3.03 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Minimum conduit trade size 1/2-inch diameter except all homeruns and where installed below grade outdoors conduits shall be 3/4-inch minimum diameter. Prewired 3/8 inch diameter flexible conduit not to exceed 72 inches in length may be used for fixture whips from an outlet box to recessed light fixture.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Route conduit parallel and perpendicular to walls and adjacent piping.
- D. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- E. Locate holes in joists within center third of member depth measured from the edge and at least 24 inches from load bearing points. Maximum hole diameter one inch.
- F. Support conduits from building structure with conduit straps or rods and hangers. #8 solid wire and CADDY clips may be used to hang 3/4-inch diameter conduit and smaller above accessible ceiling spaces.
- G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- H. Do not support conduit with perforated pipe straps or tie wraps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- I. Do not bore holes in truss members or notch structural members.
- J. Steel conduit installed as part of a 2 hour fire rated wiring assembly shall be supported 5 feet on center where required by the cable system installation requirements.

3.04 CONDUIT INSTALLATION

- A. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp locations.
- B. Use conduit bodies to make sharp changes in direction, as around beams.
- C. Use factory elbows for PVC conduit and for bends in metal conduit larger than 1 inch. Conduit bends for signal systems that are greater than 45 degrees shall be minimum radius sweeps as follows:

Under 2 inches	Standard radius
2 inches - 3 inches	24 inch radius
Over 3 inches	36 inch radius

- D. Use factory RGS elbows for PVC conduit runs below grade.
- E. Install insulated bushings on each end of conduit larger than 1 inch.
- F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- G. Install pull wire in empty conduits.
- H. Conduit in Concrete Slabs Above Grade: Do not install in concrete slabs above grade except where written approval and installation requirements are provided by the Architect/Engineer.
- I. Metal Conduit Installed Below Grade: Provide 20 mil thick factory PVC coating or field wrapped using corrosion protection tape and primer system with 50 percent wrap overlap; extend 8 inches above grade at risers.
- J. Install flexible conduit thru oversized bushed sleeve or cored opening where conduit crosses building wall expansion or seismic joints. Provide up to 54 inches of flexible wiring with 6 inches minimum of conduit slack each side of the wall assembly to allow for free movement across the joint.
- K. Do not install conduit in concrete slab on grade.
- L. Do not install conduit in direct contact with underside of roof deck.
- M. Seal all underground conduits entering and terminating within a building or structure using approved non hardening duct seal putty or a sealing bushing. Seal spare conduits using a watertight blank plastic duct plug. Seal all underground conduits entering and terminating below grade, such as in a crawl space or basement, using an approved closed cell foam sealant system.

3.05 CONDUIT PENETRATIONS

- A. Roof Penetrations: Provide sheet lead flashing (4 pounds per square foot) around each conduit which penetrates a roof. Extend 10" in all directions from conduit, and up 8" on conduit sized to match conduit diameter. Seal top of flashing around conduit with a weatherproof non-hardening mastic.
- B. Exterior Walls: Core drill or cast sleeve for each conduit one size larger than conduit diameter. Seal all openings at each penetration with acrylic weatherproof caulking suitable for painting. Below grade seal with "Chase-Foam" silicone sealant or other approved method acceptable to Architect/Engineer.
- C. Interior Walls and Partitions: Cut one size larger than conduit diameter.
- D. Fire Rated Construction: Comply with requirements of paragraph, FIRE RATED CONSTRUCTION, this specification.

3.06 CONDUCTOR INSTALLATION

- A. Minimum Conductor Size: #12 AWG, except #10 AWG minimum for outdoor and exterior building lighting circuits and #14 AWG minimum for control circuits and for lighting fixture taps not to exceed 72 inches.
- B. Splice conductors only in junction or outlet boxes and handholes.
- C. Arrange conductors neatly at termination such that a clamp-on ammeter may be used.
- D. Clean conduit free of debris before conductor installation; install conductors using pulling lubricant.

3.07 CONDUCTOR IDENTIFICATION

- A. Provide non-metallic wire markers on each conductor in panelboards and in junction boxes having more than 6 conductors. Identify branch circuit or feeder number for power and lighting circuits.
- B. Color Coding of Insulated Equipment Ground: Solid green.
- C. Color Coding of 208/120 Volt System: Phase A - black, Phase B - red, Phase C - blue, Neutral - white.
- D. Color Coding of 480/277 Volt System: Phase A - brown, Phase B - orange Phase C - yellow, Neutral - gray.
- E. Color Coding of Switch Legs: Pink.
- F. Color Coding of Travelers (3-Way and 4-Way Switching): Purple.
- G. Provide color tracers on neutrals to differentiate circuits on multi-wire branch circuits with separate neutrals.

3.08 BOX LOCATIONS

- A. Provide electrical boxes for outlets, junctions and equipment connections as shown and as required for splices, taps, wire pulling, and code compliance.
- B. Electrical box locations shown are approximate unless dimensioned. Obtain equipment outlet locations from equipment manufacturer prior to rough-in. Coordinate outlet and wall switch locations with casework and finish elements shown on Architectural drawings. Install to fit conditions or as directed.
- C. Change location of wall outlets, wall switches, and lighting outlets up to fifteen feet without charge when requested by Architect/Engineer prior to installation.
- D. Height of outlets unless otherwise directed: See Drawings.

3.09 BOX INSTALLATION

- A. Set wall outlet and wall switch boxes vertically.
- B. Support boxes independently of conduit, piping, and ductwork; securely fasten in place.

- C. Provide recessed outlet boxes in finished areas. Flush front edge of box or plaster ring even with finished surface.
- D. Provide blank cover plate over all boxes that do not contain devices or are not covered by equipment.
- E. Do not install flush boxes on opposite sides of a wall within the same stud space. Maintain 24 inch minimum box separation in fire rated wall assemblies.
- F. In-Ground Boxes: Set on 9 inch minimum deep gravel base extending 6 inches minimum beyond each side. Set flush with final grade.

3.10 WIRING DEVICES

- A. Ground Fault Circuit Interrupter (GFCI) Protection: Provide for receptacles located outdoors, within 6 feet of sinks, in bathrooms, kitchens, indoor wet locations, locker rooms with associated shower facilities, elevator pits, elevator machine rooms, crawl spaces, garages, service bays, rooftops, at counters and work surfaces where food and/or beverage preparation occurs, water coolers, and as otherwise indicated. GFCI receptacles are not required where branch circuit is protected by GFCI circuit breaker.
- B. Ground Fault Circuit Interrupter (GFCI) Protection, Dwelling Units: Provide for receptacles located outdoors, within 6 feet of sinks, in bathrooms, indoor wet locations, crawl spaces, unfinished basements, garages and accessory buildings, at kitchen counters and work surfaces where food and/or beverage preparation occurs, water coolers, and as otherwise indicated. GFCI receptacles are not required where branch circuit is protected by GFCI circuit breaker.

3.11 FIRE RATED CONSTRUCTION

- A. Verify location of fire rated walls and ceilings with Architectural plans prior to rough-in.
- B. Installation of boxes, rough-in cans, conduits, and sleeves that result in membrane or through penetrations shall comply with IBC 712.1 through 712.4 as required to maintain fire rating of construction assembly. Coordinate locations and construction requirements with General Contractor.
- C. Provide approved conduit and/or pathway sleeve kits for installation of open cable through fire rated construction.

3.12 LABELING

- A. Outlets: Identify panel and circuit number on faceplate of convenience and special purpose outlets. Use self-adhesive, polyester or vinyl laminated labels with machine generated alpha-numeric circuit identification, 1/4-inch high black letters on clear background. Exception: Use white letters on black or brown color device plates.
- B. Junction Boxes: Label or mark cover with panel and circuit number. Locate on inside of cover except locate on outside of junction box cover in attics, crawl spaces, equipment rooms and above accessible ceilings.

3.13 TESTS

- A. Perform continuity test on all feeder and branch circuit conductors. Verify proper phasing and that no short circuits or accidental grounds exist.
- B. Check all convenience outlets for correct wiring connections using a polarity circuit tester. Test AFCI and GFCI circuits for proper operation with an approved tester.
- C. Torque test conductor lug terminations to manufacturers recommended values.
- D. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be no less than 4 oz. (115 g).

END OF SECTION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Concrete for Equipment Pads: Comply with Division 03 - Concrete.
- C. Commissioning of Electrical Energy Metering: Comply with Division 01.

1.02 SECTION INCLUDES

- A. Disconnect Switches.
- B. Fuses.
- C. Enclosed Circuit Breakers.
- D. Nameplates.

1.03 SUBMITTALS

- A. Submit product data for enclosed circuit breakers. Dry type transformer submittal must indicate compliance with minimum efficiency requirements specified.
- B. Submit shop drawings for dry type transformers. Include installation requirements for anchoring and bracing meeting requirements of the International Building Code for Seismic Design Category F.
- C. Coordinate dimensions of equipment with site and project space dimensions to verify equipment will fit, conform to indicated layout, and meet NEC and manufacturer clearance requirements.
- D. Submit reports for tests required under Part 3 of this section. Submit manufacturer's performance testing instructions and signed written performance test records for equipment ground fault protection systems.
- E. Submit product data and shop drawings for service switchboard to serving utility for review and approval in addition to Architect/Engineer submittal requirements.

1.04 OPERATION AND MAINTENANCE DATA

- A. Include data for switchboards, panelboards, circuit breakers, motor controllers, transformers, fuses, contactors, busway, studies, and tests in Operation & Maintenance Manuals.

1.05 SPARE PARTS

- A. Fuses: Furnish to Owner 3 spare fuses of each type and rating installed.
- B. Fuse Pullers: Furnish 2 fuse pullers to the Owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Switchboards, Panelboards, Circuit Breakers and Disconnects: Square 'D', Siemens, Cutler-Hammer, General Electric - ABB.
- B. Fuses: Bussman and Littelfuse.
- C. Dry Type Transformers: Square 'D', General Electric - ABB, Siemens, Cutler-Hammer, Federal Pacific.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Circuit Breakers: UL 489; molded case circuit breaker with thermal magnetic trip fixed mounted, single handle common pole operation, AIC rating greater than available symmetrical short circuit amperes.
- B. Electrical Ratings, Configuration, and Special Features: As shown on drawings. The indicated ampere interrupting capacity (AIC) shown on the drawings is the full rms symmetrical equipment short circuit rating of bussing and of all overcurrent devices installed.
- C. Enclosures: NEMA ICS6; Type 1 for dry locations, Type 3R for damp or outdoor, with pad locking provisions, and suitable for use as service equipment. Include neutral and/or ground kits as required.

2.03 DISCONNECT SWITCHES

- A. Safety Switches: NEMA KS 1; heavy duty, quick make, quick break, handle with lock out / tag out provisions. Provide rating, number of poles, and fusing required for load served.
- B. Safety Switches for Variable Frequency Drives (VFD): Safety switches installed on the load side of VFD controllers shall include an interlock to disable controller operation when the safety switch handle is operated to the open position.
- C. Toggle Switches for Small Motors and Appliances: NEMA WD 1; horsepower rated 20 ampere general use snap switch with lock-out attachment.
- D. Switch Enclosures: NEMA ICS 6; Type 1 for dry locations, Type 3R for damp or outdoor locations.

2.04 FUSES

- A. Approved Fuses, 600 Amperes and Less, for Branch Circuits and Power Distribution:
 - 1. ANSI/UL 198C Class J low peak with time delay unless otherwise indicated except ANSI/UL 198E Class RK5 may be used in safety switches for protection of motors and transformers.
 - 2. For Protection of Circuit Breakers: Fuses must comply with NEC 240.86 series rating requirements for load side circuit breakers that are not rated for the available fault current. Coordinate series rating requirements with published manufacturer's listings for circuit breakers installed.

- B. Approved Fuses, Over 600 Amperes, for Branch Circuits and Power Distribution:
 - 1. ANSI/UL 198C Class L low peak with time delay unless otherwise indicated.
 - 2. For Protection of Circuit Breakers: Fuses must comply with NEC 240.86 series rating requirements for load side circuit breakers that are not rated for the available fault current. Coordinate series rating requirements with published manufacturer's listings for circuit breakers installed.

2.05 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on black background, affixed with stainless steel screws, adhesive acceptable in dry locations. Use black letters on yellow background for series combination rating identification.
- B. Letter Height: 1/2 inch for series combination rating identification. 1/4 inch for switchboards, panelboards, motor control centers, circuit breakers, switches, and disconnecting means; 1/8 inch for motor starters, contactors, time switches, and equipment served.
- C. Arc Flash Protection Labels: ANSI Z535.4; Self adhesive vinyl label factory installed by the equipment manufacturer with ANSI header to read WARNING or DANGER and informational text to include:

Electric Arc Flash Hazard
Turn off all power before opening.
Follow all requirements in NFPA 70E for safe work practices and for Personal Protective Equipment.
Failure to comply can result in death or injury.

PART 3 - EXECUTION

3.01 DISCONNECTS

- A. Provide a disconnect in addition to the controller disconnecting means at installed motor loads that are not in sight of motor controller as required by NEC 430.102(B).
- B. Safety Switches for Variable Frequency Drives (VFD): Provide two (2) #12 600 volt rated conductors with the motor feeder between VFD and load side motor disconnect interlock to disable controller operation when the safety switch handle is operated to the open position.

3.02 FUSES

- A. Install fuses in fusible switches.
- B. Size fuses for motor loads at 150% of nameplate full load amperes; size fuses for air conditioning and refrigeration equipment at maximum recommended nameplate rating.

3.03 CIRCUIT BREAKERS

- A. Install circuit breakers in accordance with manufacturer instructions and recommendations.

- B. Set adjustable breakers to comply with the approved protective device coordination study or as directed by the Engineer.

3.04 NAMEPLATES AND LABELS

- A. Individual Enclosed Circuit Breakers, Safety Switches, and Disconnecting Means: Provide nameplate to identify load served and circuit source and circuit number.
- B. Equipment Served: Provide nameplate to identify equipment designation corresponding with nameplate of serving overcurrent device, disconnect switch, or controller when there is more than one of same type of equipment being served, e.g. Air Handler No. 2. Coordinate with Architect/Engineer to assign numbers when not designated in equipment schedules.
- C. Nameplate and Label Location: Secure to equipment fronts, except recessed panelboards in finished locations secure nameplates and labels to inside face of door.
- D. Service Equipment: Provide label identifying short circuit rating indicated along with date of construction documents.

3.05 TESTS

- A. Motors and Compressors: Record all nameplate data. Measure actual voltage and running amperes for each phase. Record manufacturer and catalog number of overload thermal units installed.
- B. Dry Type Transformers: Measure primary and secondary voltages after loads are connected and systems are energized. Adjust taps for -1% to +2% of rated secondary voltage.
- C. Equipment Ground Fault Protection Systems: Test prior to being placed into service to verify proper installation and operation of the system as determined by the equipment manufacturer's published instructions. Set pick up for 300 amps and time delay for zero (instantaneous) unless otherwise indicated or directed. Record test results.
- D. Outdoor Dry Transformer Ground Electrode System: ANSI/IEEE 81; measure and record ohmic value by performing fall of potential tests using a ground testing megger. Tests shall be performed with the ground electrode system disconnected/isolated from neutral and with the test current probe located at least 100 feet from the nearest ground system electrode.

END OF SECTION

